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MACHINERY

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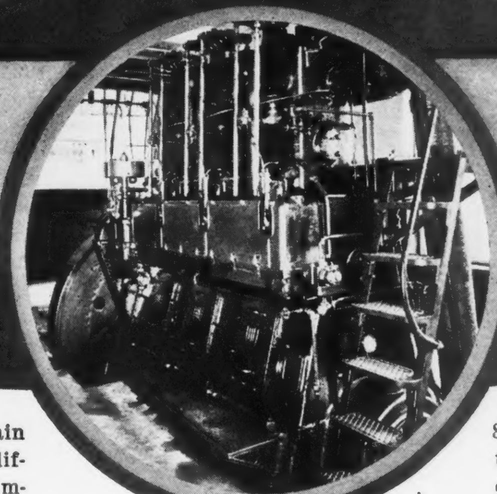
Building Vertical Oil Engines



By FRED R. DANIELS

THE machine work on the main parts of a large Diesel engine differs from that performed on similar parts of smaller engines mainly in regard to the way in which the heavy castings are handled. Jigs and fixtures are used wherever possible, but, obviously, since production cannot be maintained on a quantity basis, their use is somewhat limited. A few operations on the engine bed, frame, crankshaft, cylinder liner, piston, connecting-rod (shown assembled in Fig. 2), and flywheel have been selected as typical for this class of work.

In the plant of the De La Vergne Machine Co., New York City, rough heavy castings like the bedplate and cylinder frame are first laid out for machining to determine if the casting will clean up and to ascertain that it has not warped too much and that it is otherwise suitable for service. In laying out, an allowance of ½ inch is left for finish on the bedplate and the cylinder frame, and for other castings a proportionate amount.

The bedplate casting is first planed on the top surface to form a bearing for the frame, and on the bottom surface for the foundation. After drilling, tapping, and studding all cap bolt and frame bolt holes, as well as the horizontal holes, the crankshaft bearing caps are assembled, this work being performed on the floor. A radial drilling machine is used for drilling the vertical holes, and the holes are drilled from centers located by the lay-out man. The horizontal holes are drilled on a Delamater horizontal drilling machine, the platen of which may be moved sidewise on a rack. This machine is shown in operation in Fig. 6.

The bedplates with caps assembled, then go to the special Niles boring and milling machine shown in Fig. 1, where they are bored to receive the main bearing shells, and the ends of the bearings are faced. An 8-inch boring-bar of sectional construction, carrying two roughing tools for each bearing is used, and about ½ inch of metal is removed in this operation by the two tools. The bar revolves at from 8 to 10 revolutions per minute, with a feed of 3/64 inch per revolution. In finishing, the same set-up is used with a speed of 5 revolutions per minute and a feed of about ¼ inch per revolution. Fly cutters are then used in the bar to face both sides of the bearings. It requires 3½ hours to rough-bore a four-cylinder engine bed, 1½ hours to finish-bore it and 6 hours to face both sides of the four bearings. This machine is motor-driven and requires one man to operate the control mechanism, and another to set up the tools and give signals to the man on the platform.

Fig. 1. Boring Engine Bed with Bearing Caps assembled

After boring and facing, the holes are scraped to a mandrel to receive the bearing shells, and tested for parallelism with the planed top surface. This work is of the utmost importance, because any inaccuracy in parallelism at this point will tend to force the crankshaft out of line, causing it to knock and possibly loosen the fastenings by which the cylinder frame is attached. In testing for parallelism, the scraping mandrel is used to gage from. The indicator base rests on the planed top surface of the bed while the indicator point is passed along the top of the mandrel.

The interior of the casting is cleaned and pickled with a solution consisting of two parts of hydrofluoric acid and five parts of water, the base of the casting being filled with the solution; this also constitutes a test for leakage. The casting must be oil-tight, because the lubricating system of the engine is supplied from a reservoir of oil in the bed.

The casting is now in readiness to be placed on the erecting floor, as shown in Fig. 3. The engine is completely erected

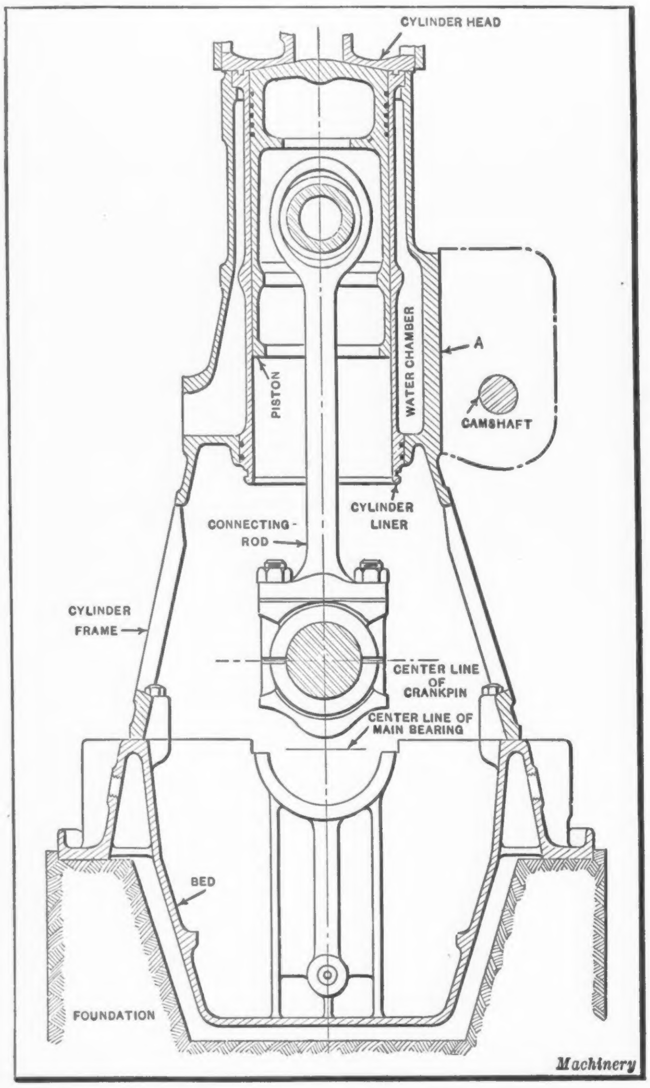


Fig. 2. Sectional View of Engine through Cylinder Frame

on the bed while in this position. (Compare with Fig. 8). The bearing caps are first removed and the shells fitted in place, where they are scraped to another mandrel having flanges to span the ends of the shells. This mandrel and some of the half shells are shown in the foreground of the illustration. In use, it is, of course, necessary to rotate the mandrel, using prussian blue to determine when all points on each bearing are in contact and all bearings in alignment. The bed is now in readiness to receive the crankshaft which is dropped into place, after which the caps are reassembled.

Machining the Crankshafts

The crankshafts have 8-inch diameter main and crankpin bearings. They are first cut off to length and centered in a lathe, and at the same time turned for "throws" or driving arms which are used in subsequent turning operations. The coupling holes in the flange are then drilled 1/16 inch small on a horizontal drilling machine. These holes are not reamed to size until the engine is finally connected up with the generator.

The turning operations that follow are performed on the special lathe shown in Fig. 4. The work is located on centers in throws *A* during the turning of each crankpin and the facing of the insides of the cheeks. This lathe has been rearranged to increase the swing by raising the tailstock and employing a large-diameter faceplate, well counterweighted. The toolpost *B* is also made especially high, to extend up to the horizontal center line of the lathe spindle.

The throws having been secured to the turned ends of the shaft by set-screws, the work is located as shown in the illustration. For the crankpins, two roughing cuts and two finishing cuts are taken. The lathe speed for roughing is 40 revolutions per minute, and for finishing, 20 revolutions per minute, the same set-up being used, with appropriate tools substituted. The gooseneck tool used in finish-turning the crankpin is ground to form a liberal fillet where the pin joins the cheek. Only two cuts are taken to face the inside of the cheek.

The final turning operation performed on this lathe is on the straight portion, screw-jacks being used between the cheeks to prevent springing. The throws are removed from the ends and the toolpost temporarily removed while the shaft is being mounted on centers. In turning, one roughing and two finishing cuts are taken, the speeds being the same as for turning the crankpins. All cuts are taken without the use of a coolant, with the exception of the final finish cut, which is performed wet.

A planing operation on a four-throw crankshaft is shown in Fig. 5. The planer is driven by a direct-connected reversing motor. The work is raised on high V-brackets at the end main bearings, and jacks are used between the cheeks to prevent springing under the thrust of the cut. Angular braces are also arranged at the central portion to prevent endwise movement. Directly under the tool-head a support is provided in the form of a bracket, in which the crankpin joining the cheeks being planed is seated.

The operations performed on this planer consist of finishing the ends and the sides of the cheeks. For the ends of the cheeks, one cut only is taken, about ½ inch of metal being removed with a 1/16-inch feed per table traverse. For planing the sides of the cheeks, three cuts are taken, two roughing and one finishing, a total of about ⅝ inch of stock being removed. It is possible, of course, when the crankshaft is located for planing the sides, to use the full traverse of the table. About 0.008 inch of stock is left for the finishing cut, in which a wide tool is used, permitting a feed of ½ inch. To take one cut on the end of each cheek requires 30 minutes; for each cut on the sides of the eight cheeks, 4½ hours.

The lubricating system of the De La Vergne Diesel engine delivers the oil from a filter and passes it through the bed. From this oil-line the lubricant is forced, under a pressure of about 10 pounds, up into each main bearing, whence it passes through an angular hole in the shaft extending to the crankpin bearing and thence through a central hole in the connecting-rod to the wrist-pin. The crankshaft, therefore, after being finished by the method already mentioned, is drilled for this angular oil-hole; a keyway is next milled

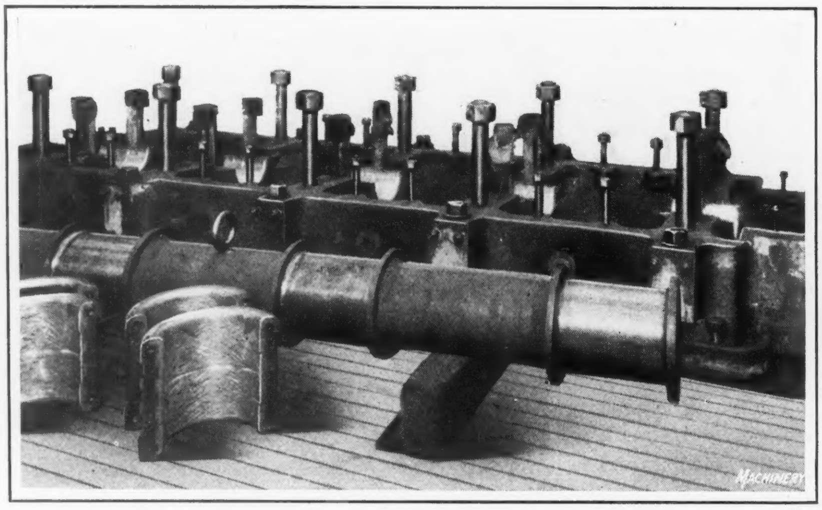


Fig. 3. Bed after boring, with Caps removed and Bearing Shells in Place

for the camshaft gear. After the rough edges of the shaft have been smoothed off, the gear is assembled on the shaft, which is then dropped into its shell bearings in the bed.

Machining the Cylinder Frames

After laying out the rough casting and checking for size, as mentioned previously, the cylinder frame is planed on the top, bottom, and camshaft pad *A*, Fig. 2. The frame is located on its side in a similar manner to that shown in Fig. 6, while one roughing and one finishing cut are taken on the pad and on the top, and two roughing cuts and one finishing cut on the bottom. The irregularity of the casting at the bottom requires the extra cut on this surface.

In boring the cylinders for the liners, the casting is located from the planed camshaft pad on a Niles boring and milling machine. The ends of the cylinders only are bored for a distance of a few inches, the intervening portion of the hole being cored to form a water cooling chamber around the liner. (See Fig. 2). The two ends are bored at the same time, the bar being arranged to bore the head end 18 inches in diameter and the crank end 17 inches in diameter. The casting has a number of pads on which covers are attached to close the hand-holes by means of which the water-jacket spaces are cleaned. These and all other pad surfaces are finished by milling, this work being done on the same type of boring and milling machine as is used for boring the liners. This is the machine shown at work in Fig. 1.

The next operation is the drilling of the bolt holes in the top of the frame, on the Delamater horizontal drilling machine with the movable platen, previously mentioned. This machine is shown in Fig. 6. The precautions taken to insure a rigid location for the casting during the operation are quite evident, and the method of performing the work needs no detailed explanation. All these holes have previously been laid out by scribing on the whitened surfaces, and the platen is moved laterally, as required, to give the correct position for each hole. The holes having been drilled, reamed, and tapped, the studs are set, except those for the cylinder head, which are the large ones shown in Fig. 7. These would interfere with the insertion of the liners, which is done before the frames are assembled on the beds.

Fig. 7 shows the frame located in a pit while the studs extending from the top are being set. This illustration also shows a number of other studded holes and the flange-covered openings for gaining access to the water jackets surrounding the cylinder liners. The importance of cleaning the interior of the casting cannot be over-emphasized, because if this is not done the lubricating oil will be sure to collect sand and grit and clog the lubricating system.

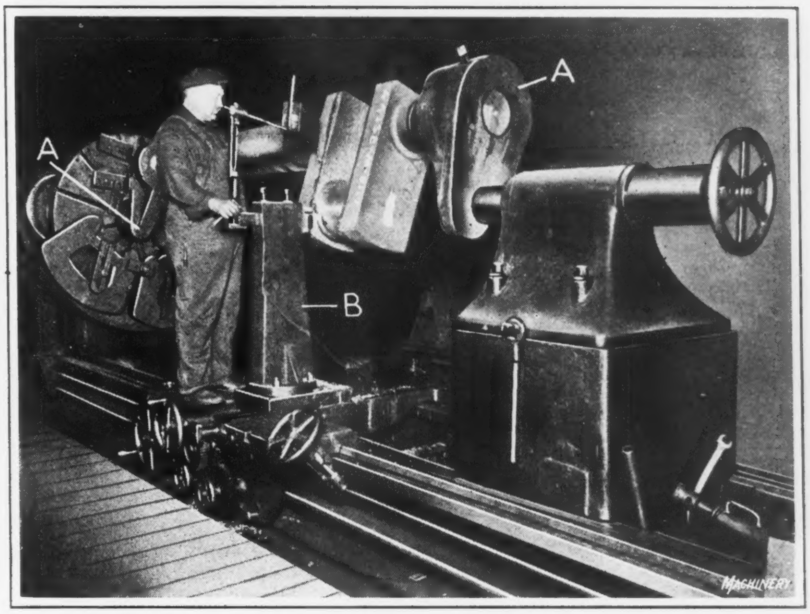


Fig. 4. Turning the Crankpins of a Single-throw Crankshaft

The liners, which are finished all over, are then lowered into the cylinder from the top. They fit tightly at the bottom, and a water-tight joint is produced by means of two rubber rings. (See Fig. 2.) They are held at the top by the cylinder head, which is attached to the frame. The arrangement is designed to allow for lengthwise expansion due to the heat of combustion. With the liners in position, the water jacket is filled and tested for leakage under a hydraulic pressure of 75 pounds. During this test the open end is covered by a flange and the water pumped in until the desired pressure is obtained.

Operations on the Liners

The liners are plain cylindrical castings, of thin wall section, and are finished by boring, turning, and facing. The first operation is performed on a Barrett cylinder boring machine equipped with two facing heads, each having a star-wheel feed. One facing head cuts off the riser and the other rough-faces the opposite end at the same time that the hole is being rough-bored. A heavy 8-inch boring-bar is used, having two tools for dividing the cut. One-eighth inch is left on the bore for finishing. The feed used for this operation is 5/32 inch per revolution, and the speed, 3 revolutions per minute.

After rough-turning the outside diameter in a lathe, the finishing cuts are taken on another cylinder boring machine, as illustrated in Fig. 9. In addition to finish-boring and finish-turning, the grooves in which the rubber packing rings are fitted are cut, and the flange at this end of the liner is finish-turned. There is a groove at the upper end of the liner into which an annular ring on the cylinder head fits, and this is also cut at the same setting.

The general arrangement and procedure are similar to that employed in rough-turning. The liner is located in two substantial cradles and clamped securely in place. These cradles engage the rough-turned portion of the liner on which no second cut is taken. The particular operation illustrated

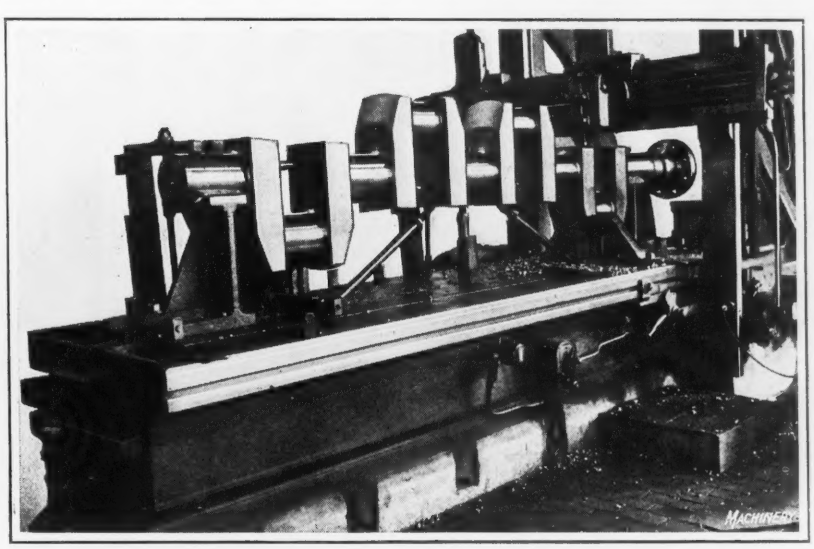


Fig. 5. Four-throw Crankshaft set up for planing the Ends of the Cheeks

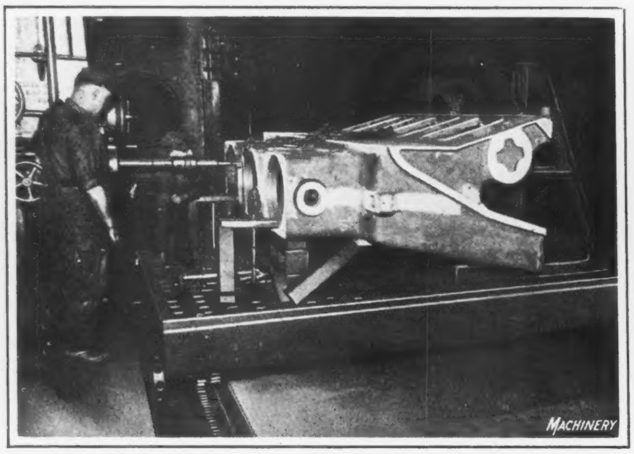


Fig. 6. Drilling Bolt Holes in Top of Engine Frame

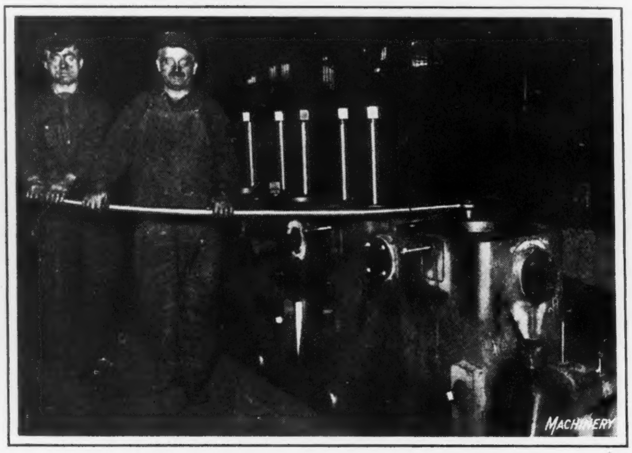


Fig. 7. Setting the Bolts in the Engine Frame

is that of finishing the flange, which must be machined to very close limits. Before the liners are assembled in the frames, they are tested individually for leakage by being subjected to a hydraulic pressure of 300 pounds. A hydraulic press showing a liner located for this test is illustrated in Fig. 10. This illustration also shows the finished appearance of the liner.

The frame with the tested liner assembled, and the water chamber surrounding it is also tested for leakage, is then transferred by crane to the assembling floor and located on the bed. This stage in the completion of the erecting is shown in Fig. 8. Through the crankcase covers of this four-cylinder engine frame may be seen the crankshaft, to which the connecting-rods, pistons, and flywheel are next assembled.

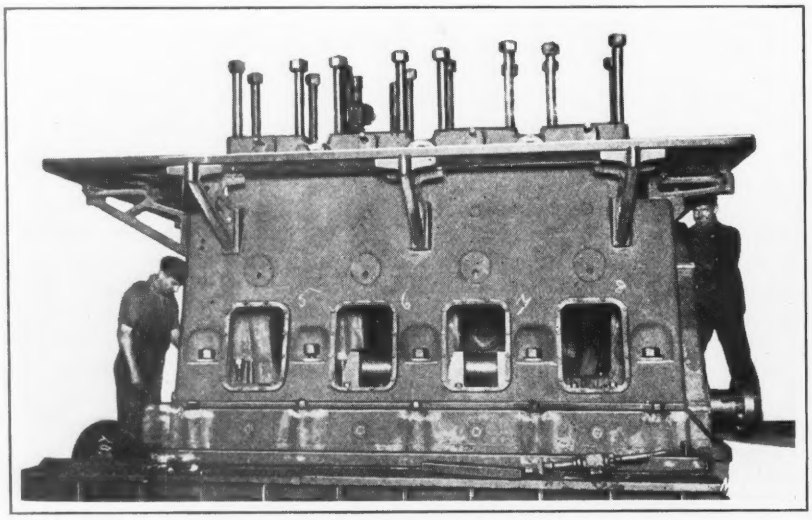


Fig. 8. Engine after the Crankshaft has been fitted, and the Frame assembled, with Cylinder Liners in Place

The flywheel is made in halves, joined at the center and fitted together by a tongue-and-groove joint. These joints at the hub and rim are first planed, after which the hubs are drilled and spot-faced for the bolts on the horizontal drilling machine shown in Fig. 6. The halves are next assembled for boring the hub and turning the outside diameter and rim. This operation, which is that shown in the illustration Fig. 11, is performed on a vertical boring mill.

During the machining, the halves are separated by a shim at the hub, and both sides of the rims are faced simultaneously, a long cutter-bar and head being used for reaching in to the under side, while a regular tool-head carries the tool for facing the upper surface. The shim used between the two halves provide for tightening the two members on the shaft. The

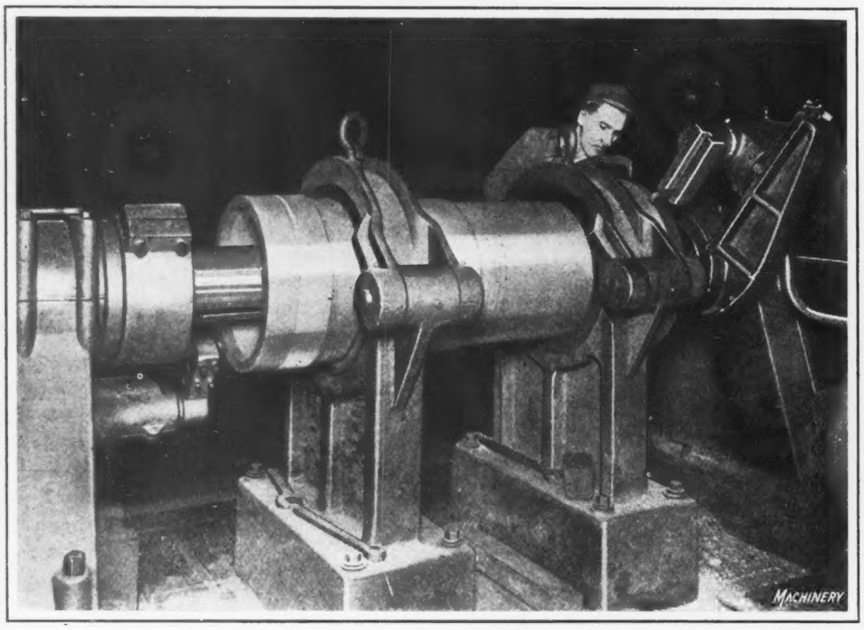


Fig. 9. Finish-facing and boring the Cylinder Liner, turning the Flange, and cutting Packing Ring Grooves

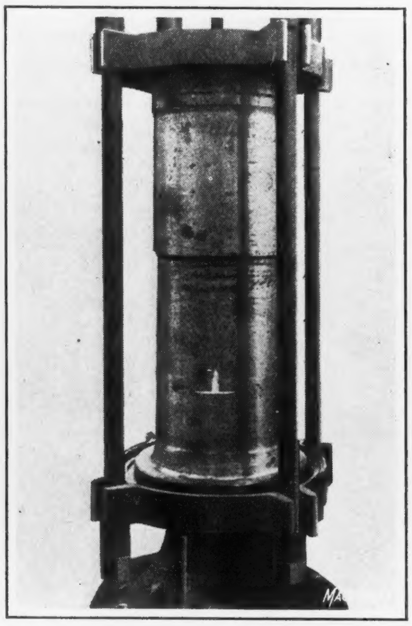


Fig. 10. Testing Liner for Leakage in a Hydraulic Press

flywheels are disassembled after the hole has been bored, and a keyway milled on a horizontal boring and milling machine, using an end-mill with the half wheel lying flat. The castings are then chipped, filed, cleaned, and assembled together.

Operations on Connecting-rod and Piston

The connecting-rod forging is turned and faced on the flange and bored to receive the brass bushing for the wrist-pin, after which an oil-hole is drilled through the center of the rod. This operation is rather unusual, because, first, an extra long lathe is required, and, second, means for constantly lubricating the boring-bar must be provided. The work is located as shown in Fig. 13; it is driven in the usual manner and supported by a steadyrest, while the boring-bar in the tailstock is fed into the work.

The boring-bar is an extra heavy steel pipe with a slot in the end in which the boring blade is fastened by pins. The blade has grooves on the cutting edge to break up the chips and allow them to be washed out as the lubricant is pumped through the tube into the hole. The pipe extends through the tailstock, and to provide for the feeding movement of the tailstock, is connected by an elbow to another pipe extending up at an angle to a joint near the ceiling and thence down at a similar angle to the coolant pump at the foot end of the lathe. The oil-hole is 1¼ inches in diameter, and the boring-bar is fed in at the rate of 1 foot per hour.

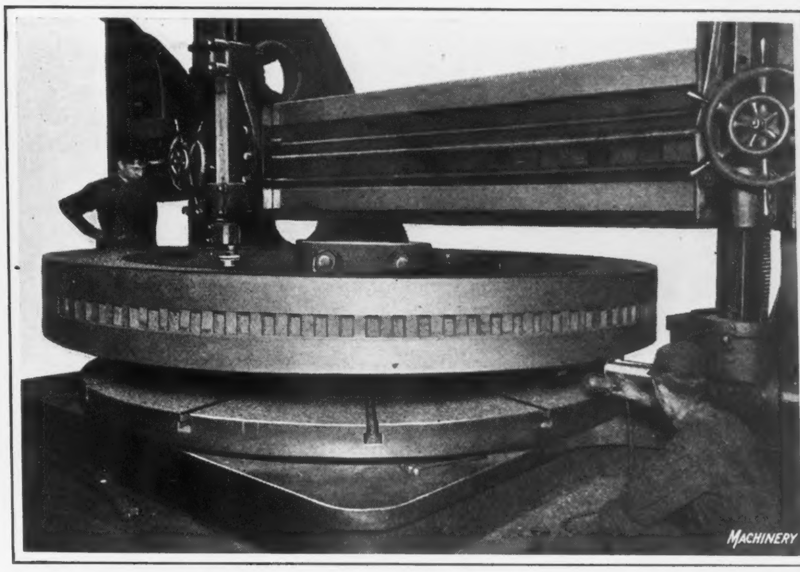


Fig. 11. Facing Both Sides of Flywheel Rim; the Hole in the Hub is bored with the Same Set-up

The remaining machining operations on the connecting-rod are performed on a horizontal drilling machine. First the two holes for the crank-pin bolts in the flange are drilled and reamed, and then holes are drilled and tapped in the wrist-pin head for the set-screws that hold the brass bushing in place. The two holes in the flange are drilled at the same time in a two-spindle machine. The brass bushing, which is a light drive fit in the end of the rod, is then assembled with the set-screws, and the crankpin box fastened to the flange. The piston and rod are finally assembled with the piston-pin, and they constitute the next unit to be assembled in the engine.

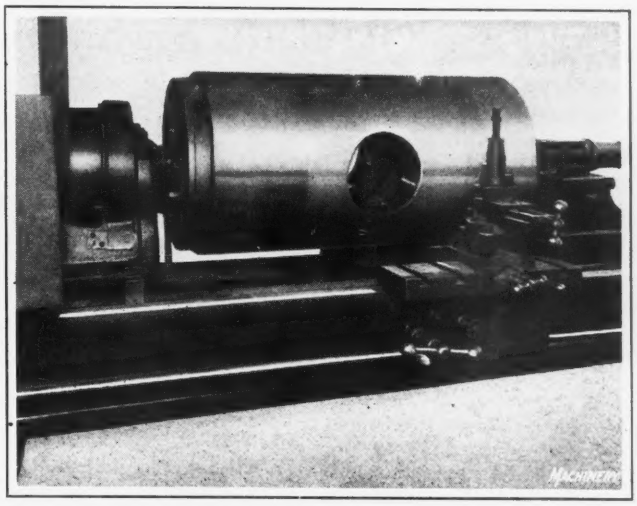


Fig. 12. Lathe equipped with Relieving Attachment for turning Clearance Spaces around Wrist-pin Holes

The piston is first cut to length, rough-turned, faced, at the head end, and polished to prevent carbon accumulation, after which six piston-ring grooves are cut. Three of the ring grooves are cut at a time with a multiple tool. The wrist-pin hole is bored with a horizontal boring-bar reserved for that purpose. The piston is placed in a special cradle, with proper liners, and one roughing and one finishing cut are required in addition to the taper reaming. The piston-pin has a taper of ¼ inch to the foot, and the holes on the opposite walls of the piston are bored straight to allow for this taper when reamed. The finish-boring cut leaves about 1/16 inch of stock for the reaming operation. The reamer carries two sets of inserted blades, spaced 14½ inches apart, which is equal to the diameter of the piston. The bar on which the reamers are carried has a pilot so that it can be passed through the reamer shells and held with a drift key. This is a very convenient feature in using the reamers, as well as in grinding them.

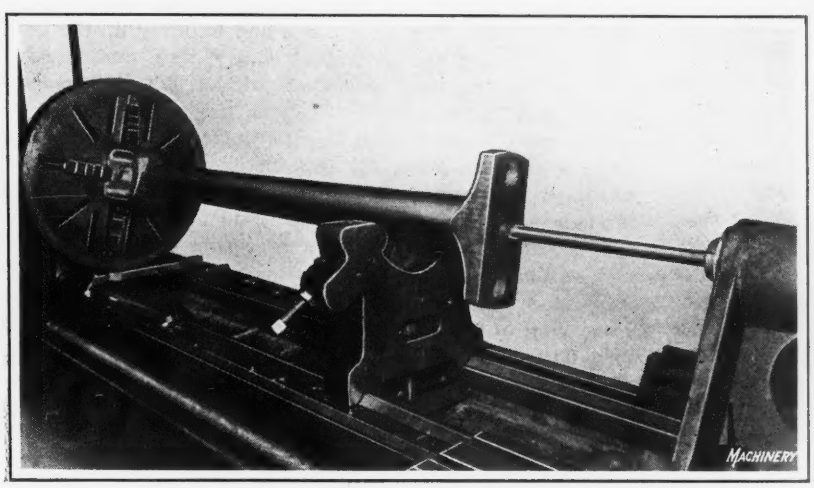


Fig. 13. Boring Axial Oil-hole through Connecting-rod

There are a number of drilling operations performed before grinding. The piston-ring grooves are drilled for brass dowels, which are slabbed to engage the rings at the joints and prevent them from turning and forming a straight line. This is quite commonly done in large cylinder engines, and is an effective means of preventing a large loss of compression through the joints. Set-screw holes are next drilled and tapped for the screws that prevent the wrist-pin from turning. There are also four holes drilled and tapped for assembling the baffle plate which prevents the oil from leaking into the piston-head. The final drilling machine operation is that of drilling and tapping for an eye-bolt in the head end, by means of which the piston is lowered into the cylinder liner.

After the dowel-pins have been assembled in the piston-ring grooves and filed to the width of the rings, the wrist-pin is scraped in and lapped with flour emery and oil, the wrist-pin itself being used as the arbor. The casting is then cleaned with kerosene and the wrist-pin assembled with a set-screw and key.

In grinding, the piston-pin is left in place, its ends being just below the surface. This is done so that the conditions under which the grinding is performed will closely approximate those under which the piston functions. After grinding, the final operation of turning a relief on each side surrounding the wrist-pin is performed. This is illustrated in Fig. 12, which shows a special lathe with an expanding chuck, the jaws of which are operated by set-screws from the periphery. The chuck is attached to a face-plate, the periphery of which forms a cam for controlling the relieving attachment by means of which this clearance space is turned. As soon as the piston has been cleaned, it is assembled with the connecting-rod and taken to the assembling floor.

Machining the Cylinder Head

The last engine part to be considered at this time is the cylinder head, which contains the cored combustion chamber and the intake and exhaust valves. It is assembled to the top of the frame, and fits into an annular groove turned in the cylinder liner. The casting is laid out and then rough- and finish-faced on the top and bottom, leaving the ring by means of which the casting is fitted to the liner. The holes are then bored for the valve gages. Both of these operations are done on a Bullard vertical boring mill. The numerous pads are then milled on a Lucas milling machine, following which the casting is drilled, tapped, and studded complete. For this work a radial drilling machine is used, and the holes are located by a jig plate. The casting is then cleaned and tested for leakage and finally assembled as shown in Fig. 2.

* * *

WESTINGHOUSE SCHOLARSHIPS

Four scholarships, each of $500 a year, are awarded annually by the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., to employes or sons of employes, on the basis of competitive examinations. Each scholarship is for four years, so that the total number of scholarships in force at one time is sixteen. Of the group of four men completing their work last year, one graduated as the leading man in the Engineering School at the University of Pittsburg, and two others stood high on the list in the Engineering Division at the Carnegie Institute of Technology.

In selecting the men for these awards, emphasis is placed on many characteristics of the applicant. His general intelligence, his physical qualifications, the aptitude that he has shown for practical engineering work, and his ability to shoulder responsibility and to guide his own personal affairs are some of the points on which the candidates are compared, in addition to their actual knowledge, as displayed in the examinations. It is considered that general intelligence is more essential than acquired knowledge; this characteristic is measured by the applicant's ability to grasp quickly and accurately a new point and to retain it. In general school work, intelligence may be judged by the student's mastery of such subjects as do not depend especially on memory, such as algebra, geometry, and physics.

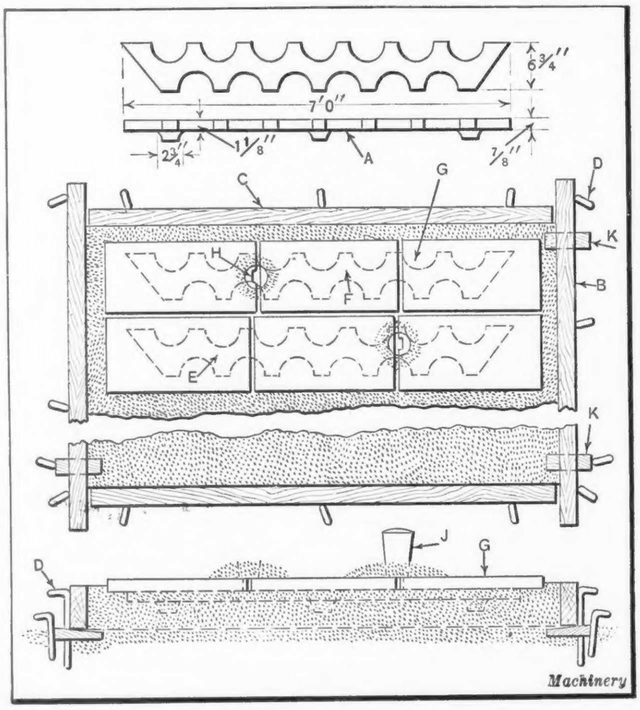
There is a special object in making these scholarships only $500 a year. It is believed by the Westinghouse company that the scholarships should be awarded only to those who are willing to help themselves to a considerable extent, and it is recognized that the scholarship is not quite large enough to cover the entire expenses involved in attending a high-grade engineering college. The amount, however, is sufficient to put engineering training within the reach of those who are able and willing to augment the amount of the scholarship by earnings through their own efforts.

BEDDING-IN METHOD OF MOLDING

By M. E. DUGGAN

Patternmakers who do not have the privilege of visiting the foundry often, but who depend chiefly on technical journals to give them information on molding and core-making, will doubtless find the method described in this article of interest. Twelve castings of the size and shape indicated at *A* in the illustration were required to be made as quickly as possible. As no flasks were available for making the molds from the two patterns *E* and *F* that were sent to the foundry, it was decided to produce the castings by making twelve bedded-in molds.

First, a space large enough to accommodate the molds for twelve castings was cleared away on the foundry floor and carefully leveled off. Some straight wooden rails, 2 by 4 inches, such as shown at *B* and *C*, were put down on the floor to form a frame of sufficient length and width to contain the twelve molds. Gaggers *D* were then driven in the ground to hold the rails in position and wedges *K* were placed under the rails at different points. The tops of



Bedded-in Molds with Cover Cores

the rails were next leveled by adjusting the wedges *K*. Just enough molding sand was filled in at one end of the frame to permit molding two patterns, as indicated at *E* and *F*.

By filling in only enough sand for two molds at a time, it was possible for the molder to stand inside the frame where he could conveniently reach all parts of the mold when extracting the pattern, repairing and blackwashing the mold, setting the cover cores, and building up the pouring basin. After the patterns *E* and *F* were tamped down and the molding sand struck off with a straightedge at a point about ½ inch below the rails, the pattern *F* was removed and the stock cores *G* put in place. When the cover cores *G* were in place, the edge of one core on each mold was filed away so that a slot or opening *H* was formed through which the molten metal could be poured.

A pouring basin was formed over this slot by placing a wooden plug *J* on the cover cores and building up a bank of sand around this piece of wood, as indicated in the lower view of the illustration. As two patterns were available, it was found best to leave the pattern in one mold while the next mold was being made by the use of the second pattern. The pattern *F*, for instance, was drawn and used for making the third mold, while pattern *E* was left in place until the molder was ready to begin the fourth mold. Weights, of course, were put on the cover cores before pouring the metal.

Dies for Producing a Universal Joint Boot

Detailed Description of Blanking, Drawing, Trimming, Piercing, Flanging, and Wiring Operations

By N. T. THURSTON

TWELVE operations performed on straight-sided single-action punch presses equipped with dies of a number of different designs, were employed in the quantity production of the part shown in the heading illustration, which is known as a universal joint boot. Pressure was provided against the work during all the drawing operations by means of rubber buffers, and all the drawing dies were so designed with the proper radii and drawing depth that no annealing of the work was necessary in order to obtain a product of good quality. The material used in the manufacture of the joint boot was 0.050-inch thick one-pass blue annealed hot-rolled sheet steel, of a good drawing quality, sheared into strips 8 inches in width.

Combination Blanking and Drawing Die

The first operation on the part consists of cutting the blank and drawing it to the dimensions shown at *A*, Fig. 1. This is accomplished by means of the combination blanking and drawing die illustrated in Fig. 2, in which the various movable members are shown in the positions occupied at the conclusion of the downward stroke of punch *A*. When the latter is in the raised position, the top of draw-ring *B* is in the same place as the top of die ring *C*, due to the action of the rubber buffers on which the lower ends of pins *D* rest.

After a strip of steel has been placed over the die and the press has been tripped, the descending punch cuts out a circular blank 7 13/16 inches in diameter as it enters die ring *C*. The blank is held firmly between the faces of the punch and the draw-ring, and as the punch continues to descend and pushes the draw-ring with it, the work is drawn on plug *E* to the desired dimensions. When the punch again ascends, the compressed buffers expand and cause the draw-ring to follow the punch, thus stripping the shell from plug *E*. The result is that the shell remains in the punch, but at the completion of the return stroke, the knock-out device *F* is forced down so that the shell is pushed out of the punch, falling on top of the die.

The cutting edge of ring *C* is made of tool steel, hardened and ground, and is forged to a machine-steel base. The latter is mounted on a cast-iron shoe by means of four machine screws. Punch *A* has a machine-steel shank with a tool-steel cutting face forged to it. This construction gives a strongly built die of economical design. Vent holes are provided in the die plug and the die shoe to permit the escape of air confined under the work as the punch descends, while vents in the punch and knock-out device permit the escape of air confined between the part and these members. This die was mounted on a No. 75½ Bliss press.

Dies for Redrawing Operations

The appearance of the part after the second operation is illustrated at *B*, Fig. 1. This operation increased the depth, decreased the diameter of the body, and flattened the flange. The die used for this work is shown in Fig. 3. Prior to the descent of punch *A*, the top of draw-ring *B* is raised to the same level as the top of plug *C* by an arrangement similar to that used on the preceding die. The work is then slipped over the draw-ring, and as the punch descends the metal is drawn from between the faces of the punch and the draw-ring, on plug *C*. The outside diameter of the draw-ring is such that the part obtained from the preceding operation fits the draw-ring fairly close. The part is stripped from the plug at the completion of an operation by the rising draw-ring, and from the punch by a knock-out device, the same as on the preceding die. This punch is also provided with a tool-steel face, and the draw-ring and die plug are made of tool steel. A No. 74½ Bliss press was used for this operation.

The third operation produces the shape shown at *C*, Fig. 1, the depth having been increased 9/16 inch, while the diameter of the body near the open end and the diameter of the flange remain the same as before. The die employed in this operation is shown in Fig. 4, from which it will be seen that the construction and operation are similar to the preceding die. The work is placed on the raised draw-ring *A* and drawn to size as the descending punch *B* pushes the draw-ring down. One difference between this die and the previous one, however, is that the punch is made entirely

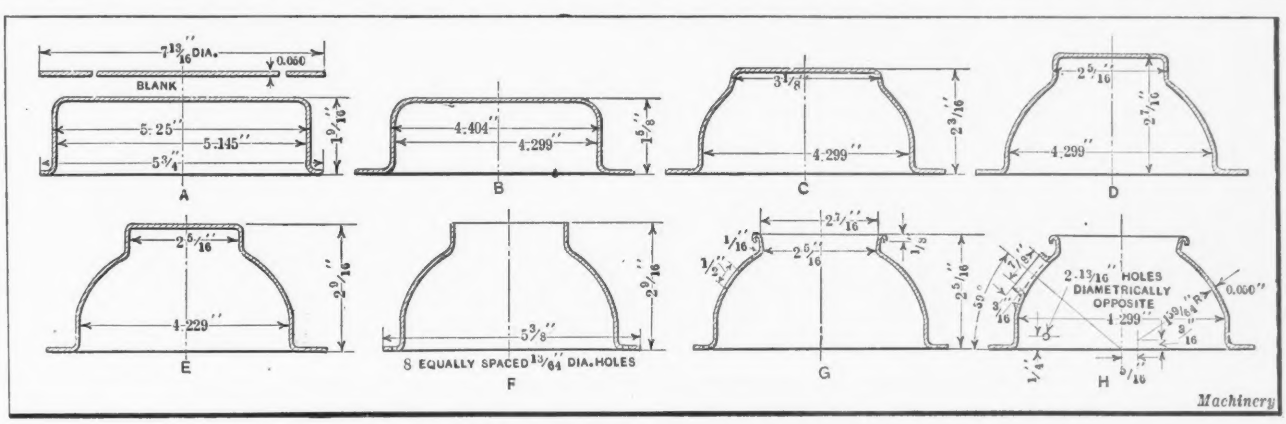


Fig. 1. Dimensions of the Universal Joint Boot after the Performance of Successive Operations

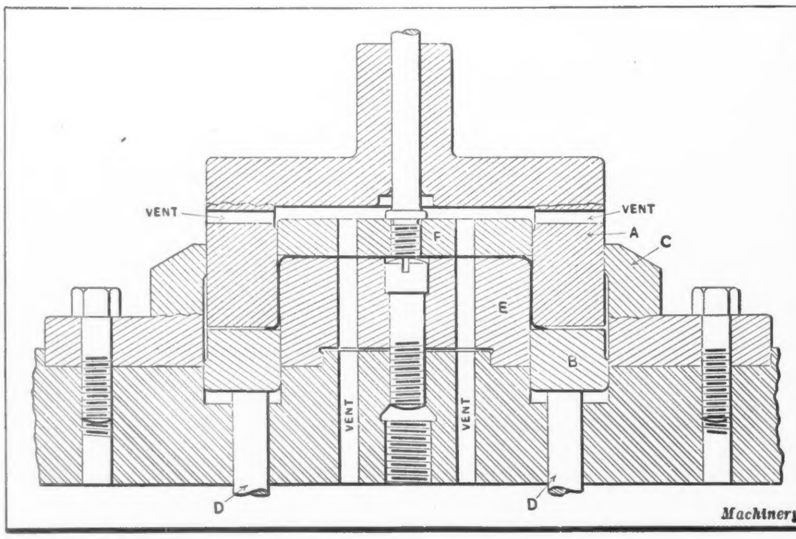


Fig. 2. Blanking and Drawing Die which performs the First Operation on the Part

of tool steel; this is a more economical construction, because of the small size of the punch, than a tool-steel ring forged to a wrought-iron or machine-steel shank. This die was also mounted on a No. 74½ Bliss press.

The fourth operation consists of drawing the closed end of the shell still further, the depth being increased ¼ inch and the diameter at the closed end, decreased 13/16 inch, as shown at *D*, Fig. 1. The dimensions of the open end, however, were not altered. This operation was performed by the die shown in Fig. 5, which is similar to that illustrated in Fig. 4, and the operation is identical. The punch, again, is made entirely of tool steel, and the operation was performed on a No. 74½ Bliss press.

The fifth operation completes the series of redrawing operations and brings the body of the shell to the shape shown at *E*, Fig. 1. The depth of the part is increased ⅛ inch by changing the rounded body slightly, the diameters of the closed and open ends remaining unchanged. This operation is performed by the die shown in Fig. 6, which functions similarly to those previously described; the drawring *A* is actuated by pins resting on rubber buffers, and the part is formed to the contour of plugs *B* and *D* by the descending punch *C*. This punch has a wrought-iron shank with a tool-steel face forged to it. The base of the die is made of cast iron, and the tool-steel plugs *B* and *D* are secured to it by means of a long machine screw. The drawring is made of tool steel. A No. 74½ Bliss press was also used for this operation.

Trimming and Piercing the Flange

In the sixth operation the flange is trimmed to the diameter shown at *F*, Fig. 1, the die illustrated in Fig. 7 being employed for the purpose. It will be seen that the part is placed in an inverted position in the die, with the body extending into the die opening, the part being supported by the flange. The latter is trimmed as the cutting edge of punch *A* enters the die opening. Two small knives *B* are attached on opposite sides of the punch for the purpose of severing the rings of scrap which accumulate around the punch. Each stroke of the press adds another trimmed off ring to the lower end of the punch, and at the same time cuts the previously trimmed ring next to knives *B*.

The shell is centered by means of gages placed in the die, and by the machine-steel plug *C* which enters the work before the punch comes in contact with the flange, thus locating the body centrally in relation to the punch and die centers. Plug *C* is pressed downward by a coil spring in the punch, which is compressed as the punch descends after the plug has entered the work. The die consists of a wrought-iron base, on which is forged a tool-steel ring that forms the cutting edge of the die. This cutting edge has four high points ground equidistant around the top, while the cutting edge of the punch is flat. This arrangement produces a gradual shearing action when the punch enters the die, and facilitates the trimming operation. The trimming die was mounted on a No. 84 Bliss press.

In the seventh operation eight holes are pierced around the flange of the shell, as shown at *F*, Fig. 1. The die used for this purpose is illustrated in Fig. 8, from which it will be seen that the work is again placed in an inverted position. The holes are punched through the flange as punches *A* descend on the work and enter corresponding holes in die ring *B*, the slugs falling through the die into a receptacle beneath. After the operation, there is a tendency for the work to adhere to the punches and so be carried out of the die on the upward stroke of the ram. To prevent such an

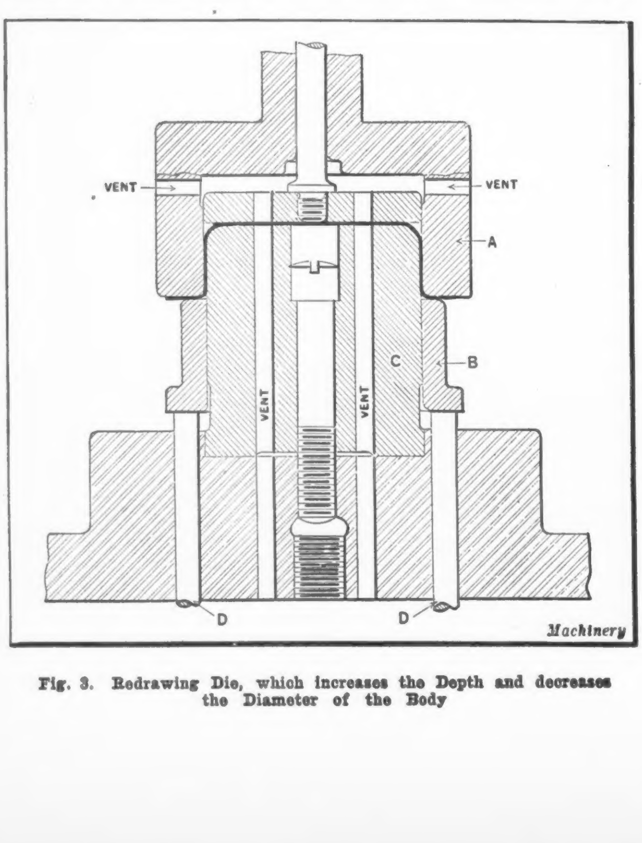


Fig. 3. Redrawing Die, which increases the Depth and decreases the Diameter of the Body

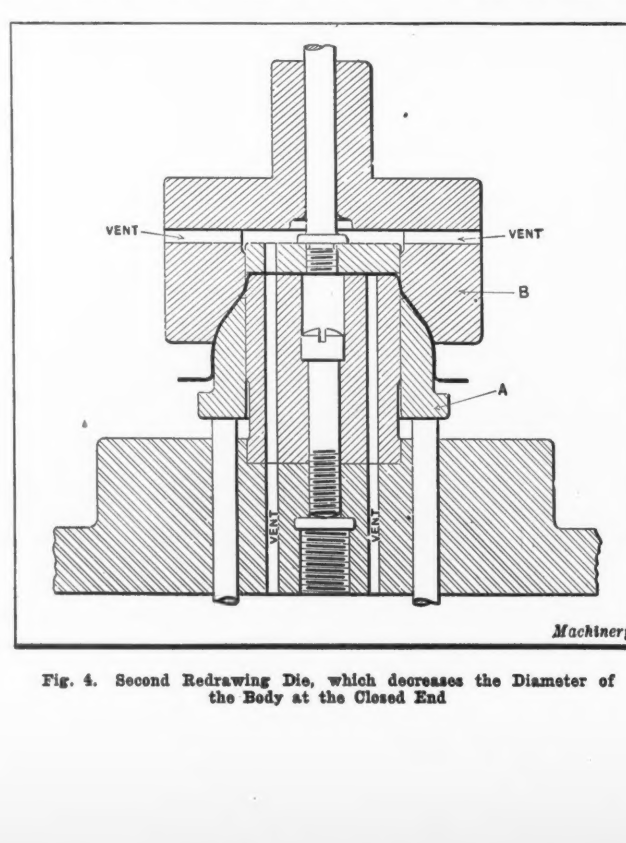


Fig. 4. Second Redrawing Die, which decreases the Diameter of the Body at the Closed End

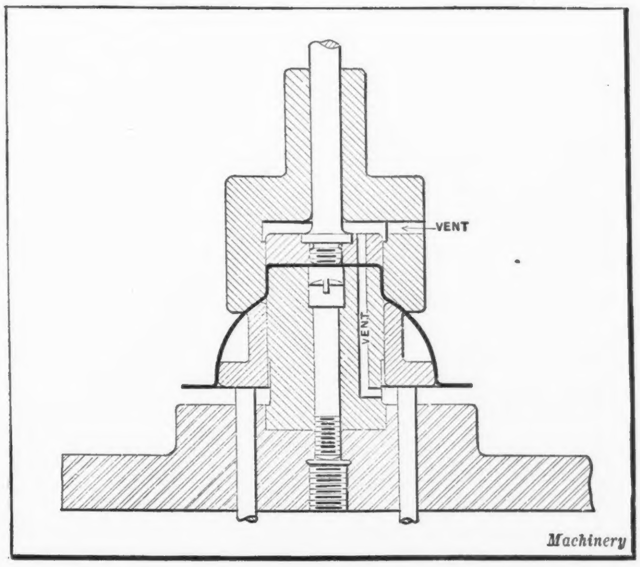


Fig. 5. Die employed for Third Redrawing Operation

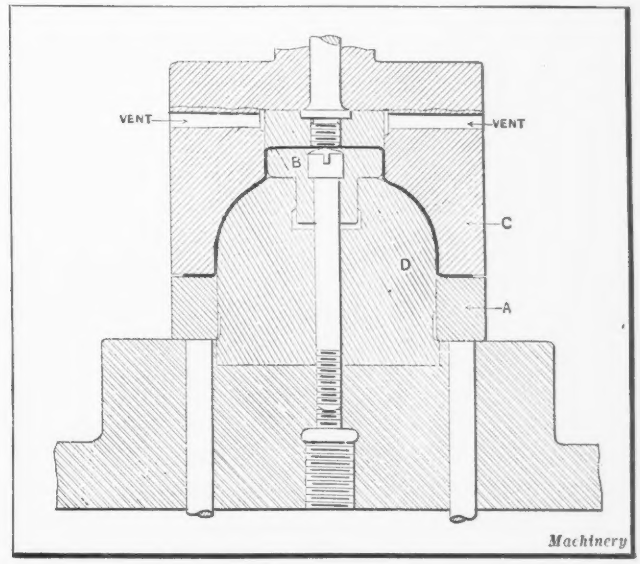


Fig. 6. Final Forming Operation on the Body

occurrence, a machine-steel stripper plate *C* is provided. This stripper is held in place by means of a standard knock-out rod, and at the end of the upward stroke, the knock-out arrangement forces the stripper down and ejects the work from the punches.

The construction of this die is very simple, the punch-holder being made of cast iron, and the piercing punches attached to it by means of set-screws placed at an angle of 2 degrees with the horizontal. The punches are made of tool steel, hardened and ground. Die ring *B* is also made of tool steel, while the base is an iron casting. For this operation also, a No. 84 Bliss press was used.

Cutting and Wiring the Small End

In the eighth operation, a hole 2 5/16 inches in diameter is cut through the closed end of the shell, as shown at *F*, Fig. 1, preparatory to wiring it. Fig. 9 shows the die employed for this operation, from which it will be apparent that the hole is cut from the inside. Ring *A* is normally in a raised position, due to the action of the rubber buffers supporting the pins on which the ring rests. The work is slipped over this ring, and as punch *B* descends, it forces the work and ring downward. When the work has reached the top of the tool-steel plug *C*, the top is sheared off by the action of the punch as it continues to push the work along the plug. Ring *A* follows the punch on the return stroke, and strips the work from the plug, while the usual knock-out device is provided for ejecting the slug from the punch opening. The punch is made of tool steel, and ring *A* is made of machine steel. This die was mounted on a No. 73½ Bliss press.

Spreading and Wiring the Small End and Piercing a Hole through the Body

The ninth operation does two things—it spreads or tapers the small end and rolls over or wires the edge, as shown at *G*, Fig. 1. The die used in this operation is illustrated in Fig. 10. The part is placed over the machine-steel plug *A*, and as the tool-steel punch *B* comes in contact with the work, the wall of the opening is spread or tapered to an included angle of 15 degrees. As the punch continues to descend, the edge of the shell is rolled over, this operation completing the small end of the work. A No. 84 Bliss press was used with this die.

In the tenth operation, a ½-inch hole is cut in the body of the shell, as shown at *G*, Fig. 1, by means of the die shown in Fig. 11. It will be seen that the work is slipped over the machine-steel plug *A*, which is secured to the cast-iron base by means of a machine-steel ring and machine screws. The work is properly located for the operation by inserting pin *B* through one of the holes previously punched through the flange. The hole in the body is cut as the punch enters the tool-steel inserted ring near the top of plug *A*. The face of the base is inclined at an angle of 39 degrees from the horizontal, in order to bring the hole in the work at the desired angular position. It will be obvious that the slugs drop

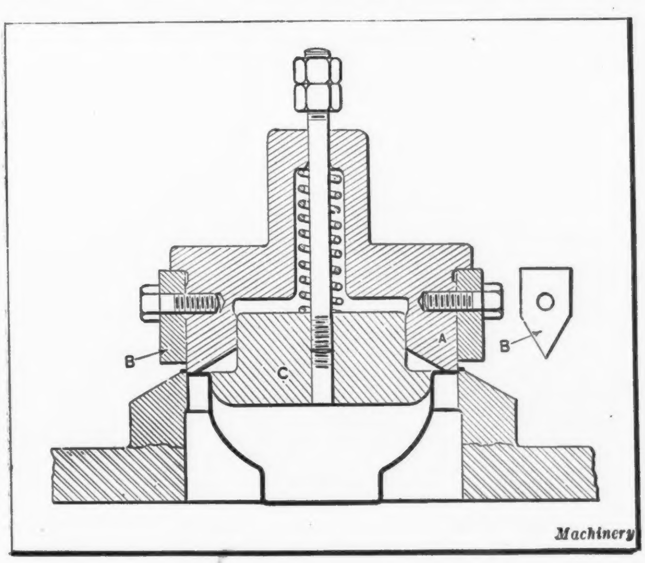


Fig. 7. Trimming the Flange to the Required Diameter

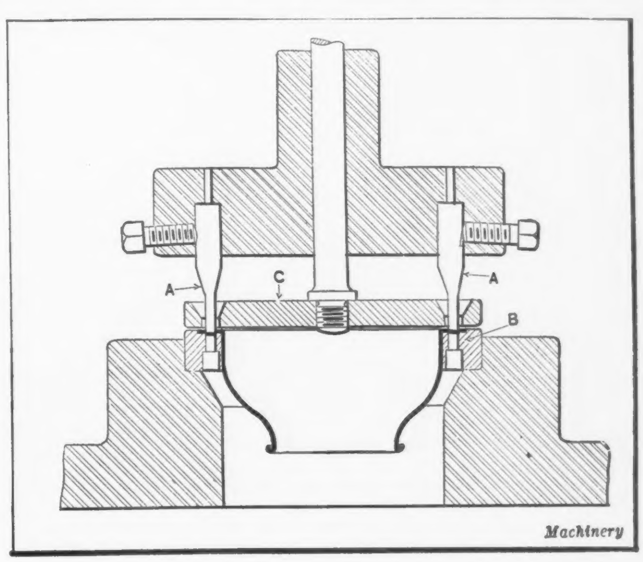


Fig. 8. Piercing Eight Holes spaced equally around the Flange

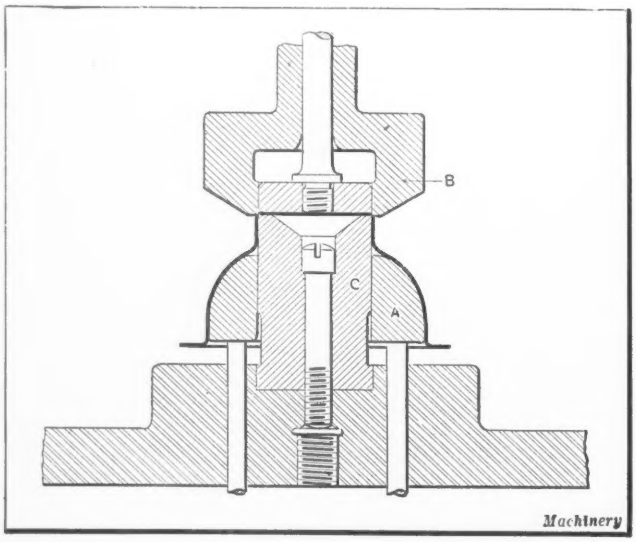


Fig. 9. Shearing a Large Hole through the Small End

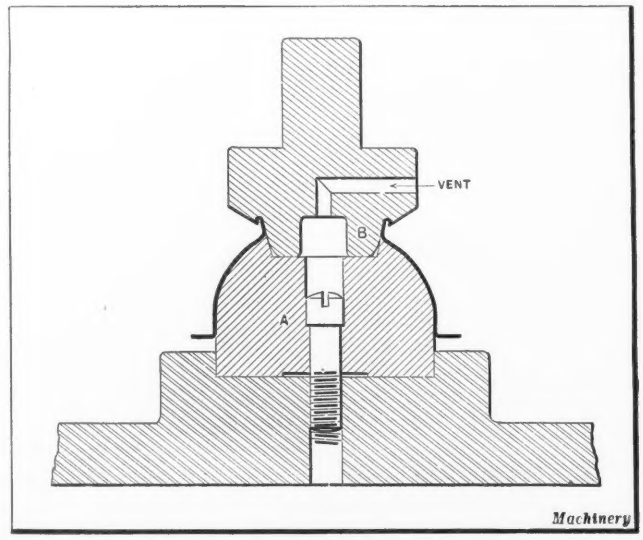


Fig. 10. Tapering and Wiring the Small End

through the hole in the die and out on the shoe. A No. 52 Bliss press was employed for this operation.

Final Punch Press Operations

In the eleventh operation, the hole punched in the preceding operation was flanged, as shown at *H*, Fig. 1, by means of the die illustrated in Fig. 12, which is of somewhat the same design as the previous one. The part is placed on the die with the upper boss of plug *A* extending through the ½-inch hole, and as the punch descends, the shell is pushed down on the plug, and the metal surrounding this hole is flanged. The punch and inserted plug are made of tool steel. A No. 73½ Bliss press was used for this operation.

The production of a drawn part, in this case, depended on the possibility of flanging a hole of this diameter to a height of 3/16 inch. Previously a cast universal joint boot was used, the opening in the body being cored, machined, and tapped. By replacing the casting by a drawn part, it was possible to eliminate all machining, and a considerable reduction in cost resulted. A drawn neck and cap were pressed into place in the flanged hole of the drawn shell, and this arrangement answered the purpose with entire satisfaction.

The twelfth and final punch press operation on the part pierces the two small holes located diametrically opposite each other on the body near the base, as indicated at *H*, Fig. 1. This operation was performed by the die shown in Fig. 13. The shell is located properly for punching each hole by a means similar to that employed in the die shown in Fig. 11, a pin being placed in two of the holes pierced around the flange. It will be obvious that the hole is pierced as punch *B* descends and enters the hole in the tool-steel plug inserted in the top of plug *A*. The slugs drop through the die and fall on the shoe as the work is removed from the plug. A No. 52 Bliss press was used for this operation. All the dies described in this article were designed and manufactured by the Acklin Stamping Co., Toledo, Ohio.

* * *

FINISH-MACHINING CAST IRON WITH OIL

Some unusually good results in finish-machining cast iron by the use of a cutting lubricant have been obtained by the Anderson Die Machine Co., Bridgeport, Conn. In machining cast-iron surfaces on the turret lathe, the roughing cuts are taken as usual, but when the finishing cut is taken, an ordinary cutting oil is used, resulting in a finish very much like that which would be obtained on steel. There is no pulling out of the particles in the cast-iron surface by the tool. The tool is ground the same as it would be for finishing cast iron dry, and there is no change in the ordinary methods except that a cutting oil is applied to the point of the tool.

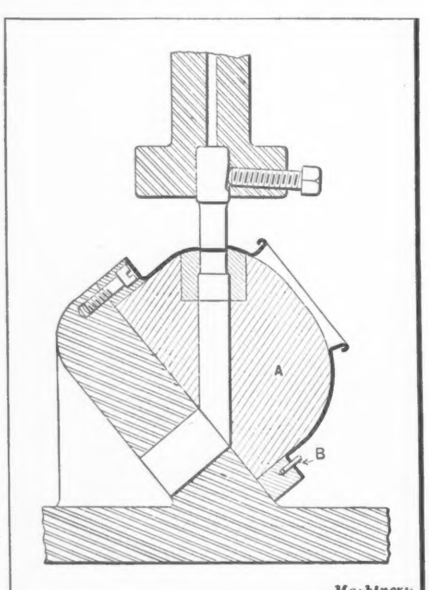


Fig. 11. Punching a Comparatively Large Hole through the Body

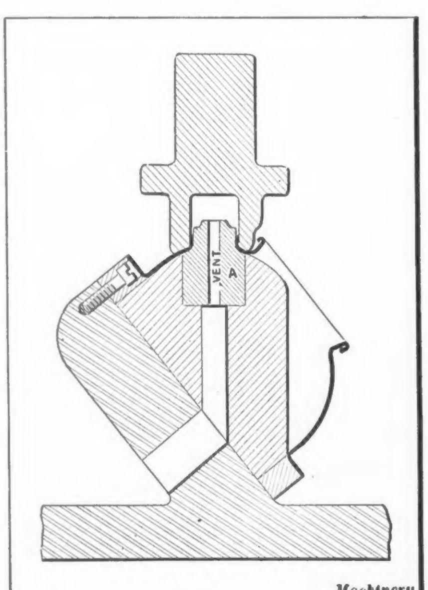


Fig. 12. Flanging the Hole punched in the Preceding Operation

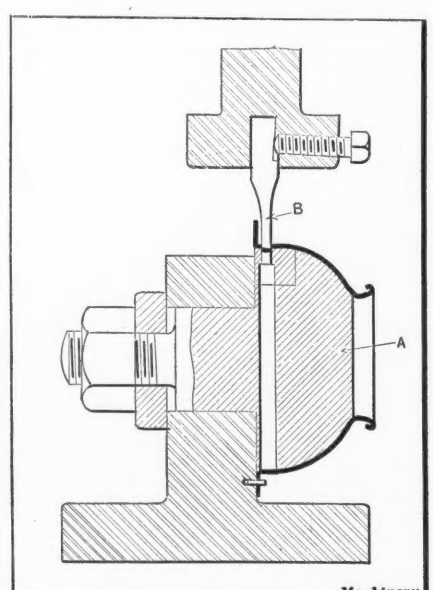


Fig. 13. Piercing Two Small Holes in the Body close to the Flange

Incandescent Lamp Machinery

THE articles on incandescent lamp machinery previously published in MACHINERY (see August, page 969, September, page 32, and November, page 214) have described a machine for coiling tungsten filament; one for uniting the glass flare, evacuating tube and lead wires; and two machines for inserting the anchor wires that support the filament. In this article, two other incandescent lamp machines made by Charles Eisler, Newark, N. J., are described; one of these is employed for forming a tube in the end of lead wires, and the other for welding the filament and lead wires together. The machine for forming the tube will be considered first.

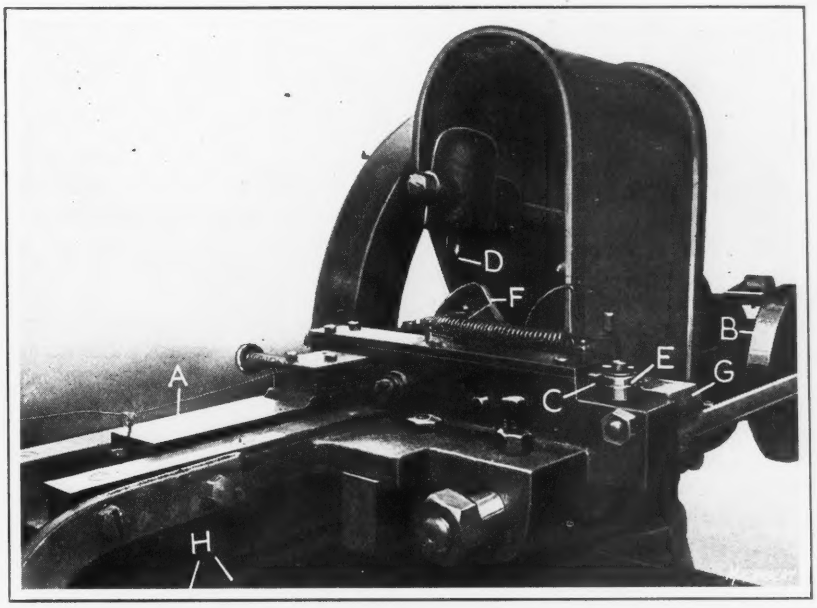


Fig. 1. Machine used for forming a Tube on One End of Incandescent Lamp Lead Wires

The Tube-making Machine

The tube-making machine is illustrated in Fig. 1. The wire is fed from a spool into a corrugated-jaw straightener attached to slide *A*. This straightener advances the wire into a pair of jaws in the machine carriage, where it is held firmly throughout the operation of the machine. The jaws are carried in the carriage, which is moved back and forth by the action of cam *B*, to which it is connected by a rod. There is a rack on the carriage and also on the under side of the slide. Between these two racks there is a small pinion. With this arrangement, each receding movement of the carriage causes an advance of the slide, and at each advance of the carriage the slide recedes.

As soon as the slide has advanced with the wire gripped in the corrugated jaws, the wire is passed between the two open jaws in the carriage (one of which projects at *C*) and through a diamond die until it extends sufficiently to lie on an anvil beneath the hammer *D*. The hammer is tripped by a cam on the camshaft, and flattens the end of the wire. Simultaneously with this flattening, cam *E* is partially revolved, to move jaw *C* and hold the wire firmly. Cam *E* is carried on a small vertical stud, the lower end of which engages a transverse slot cut in the connecting-rod, so that with every throw of cam *B*, the jaw is operated.

As soon as the wire has been flattened, the carriage recedes, dragging the flattened wire back through the diamond die which forms it into a tubular shape. Between the die and the farther side of the carriage, there is a cutter arm *F* in which the cut-off blade is carried. One end of this arm has an adjustable pin that bears on latch *G*, and the latch has a similar pin with a beveled end which comes in contact with another beveled pin extending up from the connecting-rod. This trips arm *F*, depressing the end in which the cut-off blade is carried and severing the wire. These movements occur in such rapid succession that during the time required, the slide *A* has only had time to advance one more length of wire.

The lengths of the lead wires vary considerably for different sizes of lamps; likewise, the lengths of the tubes formed at the end vary, and on that account adequate adjustments of the machine are necessary for handling all lengths. The throw of the connecting-rod may be adjusted in the slot on the side of the cam from which it is driven. Usually such an adjustment also calls for an adjustment of the travel of slide *A*, because the longer the wire, the longer the tube formed at its end. The starting point of the traverse of this slide is controlled by the setting of two collars *H* between which a pin on the carriage rack is held. This machine is capable of handling all sizes of lead wires, and the tube on the largest size of this wire is so small that it cannot be seen with the naked eye.

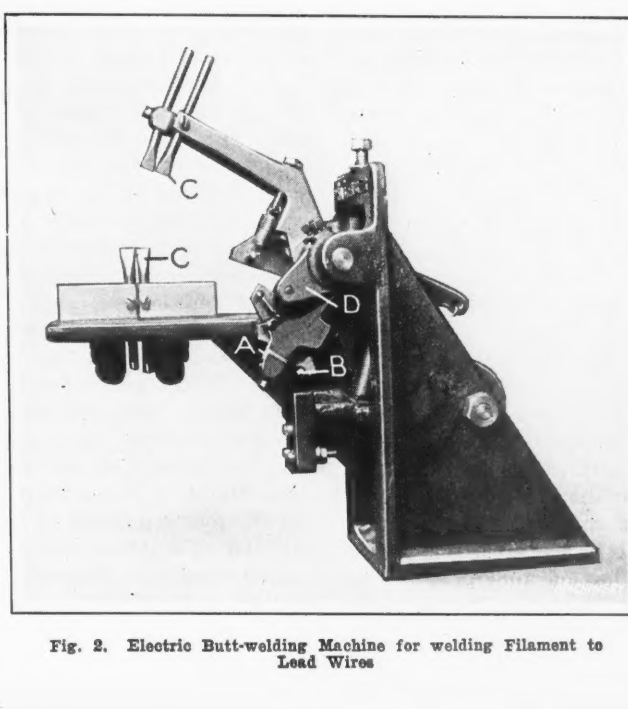


Fig. 2. Electric Butt-welding Machine for welding Filament to Lead Wires

The Welding Machine

The welding machine, shown in Fig. 2, is a bench device, operated by a foot-treadle. It is used to butt-weld electrically the lead wires to the filament. In performing the operation, one lead wire is welded to the filament, and then the operator strings the filament on its supports, (anchor wires or pigtail loops as the case may be) and brings the opposite end of the filament around to be joined to the other lead wire. During the welding, the operator must hold the frail parts in his hand, and this calls for a provision in the design of the machine that will prevent the weld from being located incorrectly, either through

carelessness or inexperience on the part of the operator. The foot-treadle is connected to a pulley at the rear of the machine and the pulley to lever *A*, so that by depressing the foot-treadle the lever is rocked until the two contact points (one of which is shown at *B*) are brought together. Alternating current at 60 cycles is used, taken from a 1 kilo-volt ampere transformer; one wire is connected directly beneath the contact point *B*, and the other to the screw shown at the top of the frame.

It requires a further depressing of the foot-treadle to bring the welding electrodes *C* together. This movement rocks lever *D*, causing the two brass arms in which the upper electrodes are carried to be depressed. The outer electrode makes contact with the corresponding lower one first, and opens the circuit. However, the welding is not done by these two electrodes, but by the two directly in back of them, so that although there is a circuit passing through the machine, the weld will not be made until the operator has had plenty of time to make sure that the delicate wires to be welded are properly placed on the inner electrode; then the pressure on the foot-treadle is further increased. This moves the inner upper electrode just enough to contact with the corresponding lower one, and pass the current through the wires to be welded. When welding double contact work, such as automobile headlight lamps, both jaws are used, as both ends can be welded in one operation. Machines of this kind are regularly operated by girls who, as a rule, are considered more dexterous in handling these small parts than men.

* * *

THE DEVELOPMENT OF RESISTANCE WELDING

A graphic history of the development of resistance welding was presented by Professor Elihu Thomson, director of the Thomson Research Laboratory of the General Electric Co., Lynn, Mass., at a joint meeting, recently held in Schenectady, of the Northern New York section of the American Welding Society and the Schenectady branch of the American Society of Mechanical Engineers.

The first conception of the idea of electric welding came to Professor Thomson in 1877. The discovery was accidental and occasioned during the last lecture in a course of five on electricity at the Franklin Institute at Philadelphia. At that time he noticed that, on passing the condenser discharge through a fine wire of a spark coil of fair capacity, while the coarse wire primary coil had its ends closely placed together with a slight pressure, what might be now called a "snap weld" was made, and the ends of the wires became so firmly joined that they had to be cut apart. The first actual machinery to perform welding operations was built in 1885, when the Thomson-Houston Electric Co., under Professor Thomson's direction, started to develop an alternating-current system with dynamos and transformers. In 1886 the "Jews-harp" coil was developed, by means of which welds could be made between bars of different metals up to about ¾ inch in diameter for iron, and corresponding sizes, according to the heat required and the conductivity of the metal, for other materials than iron. It took fifteen years to develop the process that is now so commonly employed, namely, spot welding, where two sheets of metal are laid one over the other and welded in spots by pressing the spots between heavy electrodes.

* * *

A new institution for the study of electrical engineering to be known as the Moore School of Electrical Engineering, will be conducted by the University of Pennsylvania. The late Alfred Fitler Moore donated in his will an estate valued at approximately $1,500,000, as an endowment for this new electrical engineering school. The income from this endowment will be used primarily to develop undergraduate instruction in electrical engineering. A portion of it will also be used for graduate instruction and to encourage research work on the part of both faculty and students.

DISCOVERY OF MANGANESE STEEL

Hadfield's discovery of manganese steel as a result of research practically started the study of alloy steels. Before him, Mushet had, indeed, worked out empirically a self-hardening steel for metal-cutting tools, but it gave no such impetus to research in the field of useful metals. As a young man Hadfield started experimenting in his father's steel foundry to see if he could find a hard steel suitable for tram-car wheels. He melted his mixtures in crucibles and tested his products by the means then at hand—the file, chisel, forge, magnet, and hardening and tempering. These were enough to enable him when he first made an alloy coming within the definition of manganese steel to realize that he was dealing with a new metal.

Before his time, everyone who had tried the effect of increasing manganese in steel had found that the steel was made harder and less ductile with each increase, so that if 2.5 per cent were present the product was too hard and brittle to be of any use. The highest proportion ever added had been 3.5 per cent, which made the steel even more brittle. Naturally it was believed that more manganese would merely result in still greater weakness.

Hadfield, however, took nothing for granted, but tried everything, and as a result, found the new alloy which, when it contained about 13 per cent of manganese and was properly heat-treated, had maximum combined properties of strength and toughness. He told his father, Robert Hadfield, and his superintendent, Mallaband, about his discovery. They were naturally skeptical and told him that he would better repeat his experiments. He did so, and the results obtained were the same as in the first case; then they began to take notice.

Here was a high-carbon steel which in several ways was the opposite of what would be expected by anyone familiar with iron. A magnet would not attract it, and when heated to a bright orange heat and cooled quickly, as by immersion in cold water, it was given extraordinary ductility. There were other less notable features but these were enough to excite astonishment. Naturally, the first attempts to adapt the new hard metal were for cutting purposes, particularly for metals, but experiments in that direction came to nothing. The great field for this steel, resistance to abrasion, particularly by such materials as rocks and ores, was not fairly recognized until ten years after the steel was first made.

The discovery, as the result of systematic research, of a metal having such unique properties as manganese steel, started other steel-makers to see if additional useful alloys could be found. As a result of these activities, which eventually extended throughout the civilized world, many alloy steels of great importance have been developed, which have advanced materially the useful arts and particularly the conquest of distance on land, in the air and under the sea. This discovery also argues strongly for research even without a definite object. Hadfield was searching for a hard steel for another purpose. He had no idea of finding a non-magnetic or water-toughening steel. So anyone has a chance of finding something new and useful in any systematic investigation or research that explores an unknown field of knowledge.

As usual, the inventor's reward was in this case an extremely small part of the benefit of manganese steel to the world. Years passed before the various uses for the steel were found. Everyone disbelieved when told of it. Trials for the various purposes had to be made to show its fitness. The development of the business side called for the liberal expenditure of time, effort, and money. The life of the patent, fourteen years, is too short a time to enable the inventor of anything of such extreme novelty to be suitably recompensed in a business way, though he may find satisfaction as Hadfield has, in having forwarded the welfare of the world in so great a degree.—*Research Narrative, Engineering Foundation.*

Design of Machine Tool Feet and Bases

Typical Designs for Different Classes of Machines—First of Three Articles

By FRED HORNER

IN the early days of machine tools, the feet served only as a means of supporting the machine, and they were often shaped and ornamented in much the same manner as the feet of chairs and tables. There was no thought then of heavy cuts, cooling lubricants, forced lubrication, motor drives, high speeds, and many other later developments that have made it necessary to strengthen the feet and frames of machine tools and to include facilities for receiving the chips and lubricants. Vibration was scarcely a factor to be considered at that time, inasmuch as the tools took only light cuts and accuracy of a high order was not expected.

The preliminary attempts at strengthening consisted in connecting the legs by tie-rods. This method is still utilized in certain instances. At first chips and coolants were taken care of by providing extra tins, trays, or pans of sheet iron, fixed up in a more or less makeshift fashion. As competition increased, the machine tool builders began to give more attention to the introduction of features that would more adequately meet these new conditions. Feet, frames, and pans began to appear that were cast integral with the machine body. The box frame was the greatest advance, and it has proved particularly suited to the requirements of machine tools. In many types of machines, the old-style leg supports have been replaced by a strong pillar that may be as wide and as long as, or longer than, the top of the bed or table.

The introduction of geared drives and feeds has had an important effect upon the design of machine frames and feet. A box frame is the type best suited to receive the bearings of gears and to afford protection to the latter; hence the necessary modification for these drives has exerted a beneficial influence in giving greater rigidity. The problem of vibration has largely to do with the mass of the work handled, and a strong foot and frame are essential in order to prevent flexure of the supporting surfaces. Otherwise, as in the knees of milling machines, for example, the weight of the knee, table, and fittings, along with that of the work, induces tremors in the support, with resultant chatter on the surfaces being machined.

Any gaps in the continuity of the metal composing the feet or an adjacent column have a tendency to cause undesirable elasticity. For this reason openings should be omitted, if possible, and solid webs should be made to span across the main walls in cases where a full thickness of metal does not happen to be required. Of late years sections and shapes of feet have been further stiffened, without altering their dimensions, by casting in ribs of single or double (channel) section to resist the opening or closing tendencies of the sides.

The Three-point Principle of Support

The three-point principle of supporting a heavy body is of the greatest importance in machine tool design. The object of the three-point support is to prevent warping of the machine body or frame. Of course four, five, or six supporting points would be just as satisfactory as three, provided the foundation were made perfectly true and kept true. But it is difficult to prepare and retain such alignment, and for that reason, the three-point contact, which is comparatively inexpensive as regards the cost of installation and adjustment, has the advantage. A frame with the three-contact bosses under the feet is simply placed on the floor, and requires no adjustment except for leveling.

Within certain limitations the three-point method of supporting a machine is ideal. In the case of machines having short beds, there is practically no danger of twisting or warping so long as the machine rests only on three supports. With machines having longer frames, it is possible that twist will occur, even though the slides or supporting ways have been machined while the casting rested on the three feet. To explain the matter in the briefest manner, reference may be made to the procedure recommended by the manufacturer of a universal boring machine for leveling up the bed. The floor plan of the machine is shown in the upper view in Fig. 2. There are seven points or pads cast

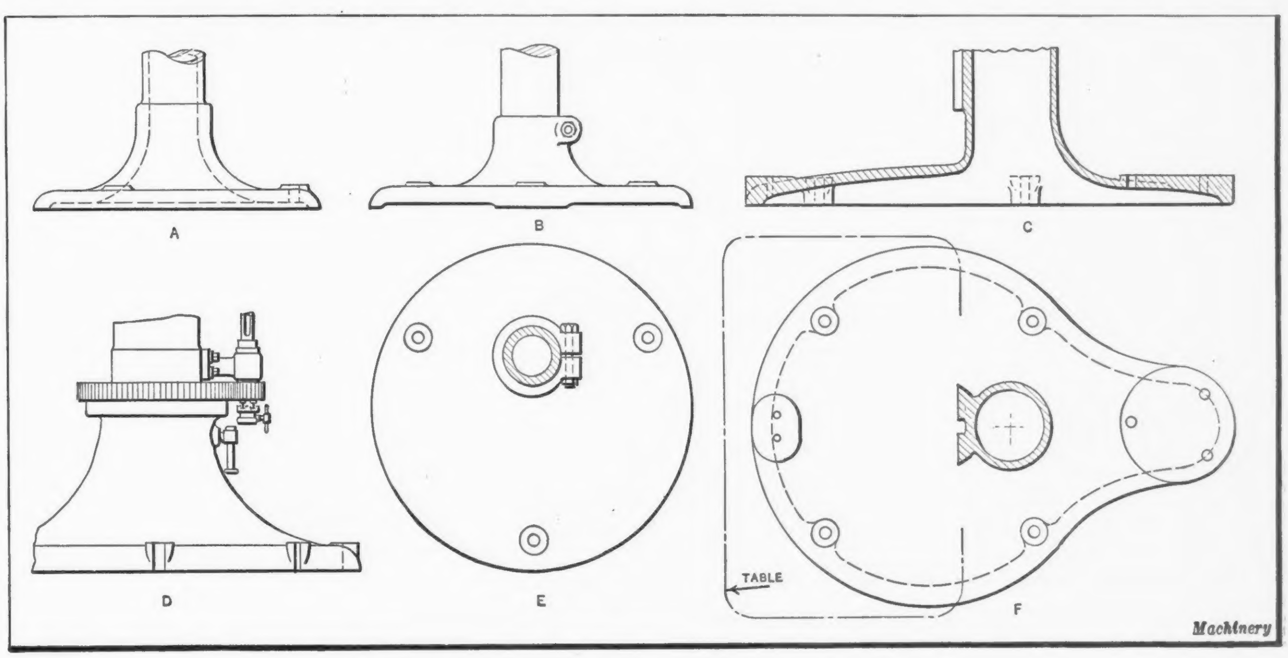


Fig. 1. Various Forms of Pedestals or Machine Feet of Simple Design

under the foot of this machine which are referred to as *A*, *B*, *C*, etc. Points *A*, *B*, and *C* are used for leveling, and points *D* and *E* for taking the twist out of the bed, should there be any after the main leveling is accomplished. Points *F* and *G* are used only for manufacturing purposes.

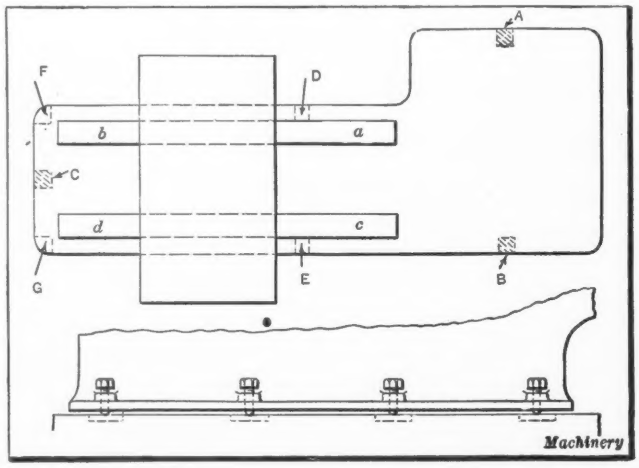


Fig. 2. (Upper View) Type of Foot used for Boring Machine; (Lower View) Machine Foot provided with Leveling Screws

For the leveling operation, five hardwood wedges, about 8 inches long, 1½ inches thick, and tapering off to ½ inch at the end, are required. The procedure followed in leveling is outlined in the following:

1. Use wedges at points *A*, *B*, and *C* to raise the machine high enough from the floor to clear all the projections under the base.
2. Place the level on the bed of the machine at right angles to the ways, so that it rests on points *a* and *c*. Then adjust the wedges under points *A* and *B* until the bubble registers level.
3. Adjust wedge *C* until the bubble registers level when the level is placed in a position parallel with the ways at *b* and *d* and also at *c* and *a*.
4. Place the level so that it rests on the ways at points *a* and *c*, and see if the machine has been thrown out of level by Operation 3. If this has happened, wedges *A* and *B* are adjusted until the machine is again level at these points.
5. Test with the level along points *d* and *c*, as in Operation 3. Adjust until level by wedge *C*, and repeat Operations 4 and 5 until the bubble registers level for both tests.
6. Place level at right angles to the ways, along points *d* and *b*. If level, adjust wedges *D* and *E*, so that there is contact against the pads, and if not level these wedges must be adjusted until the bubble indicates level. This done, place the level along points *c* and *a*, *c* and *d*, *a* and *b*, and *b* and *d*, adjusting the wedges as before until the machine is level in each and every way.

Multiple Leveling

Machines with extra long beds do not lend themselves to the three-point principle of support, because of the unavoidable sag or spring. It would be impossible or impracticable to use the three-point method of support for many machines having long beds, because of the great depth and size of casting that would be necessary to prevent sag between the contact points and insure absence of flexure and tremor under cutting conditions. For this reason, additional supports are often necessary to prevent warping. The increase in bearing points means extra wedges, and if a very solid foundation is imperative (as in planers, which are subject to tremendous shocks and jars) either a continuous solid foundation must be prepared, or brick or masonry piers placed at the wedging points. Even the plain wedges that are satisfactory for many kinds of machines are likely to become loose under a planer. The "folding" or double wedges, with screw adjustment, are preferable to the wooden ones, especially as they afford a convenient means of releveling when the machine bed is found to have been affected by the settling of the foundation.

The direct use of screws provides a convenient means of leveling in special cases, such as where a machine bed needs support in the middle or an outlying foot or auxiliary support requires delicate adjustment and occasional correction. In such cases, screw jacks may be used to advantage. A handy way of leveling is adopted for the beds of the horizontal boring, surfacing, milling, drilling, and tapping machines made by an English concern. No holding-down bolts are required if a good solid floor is provided. Bosses are cast all around the flange of the foot, as shown in the lower view, Fig. 2, into which leveling screws are inserted. Cast-iron plates about 6 inches square are placed on the floor for the screws to rest on. Loose wedges are thus dispensed with, and the leveling can be easily done by manipulating the screws. When leveled up, the bed is run with sulphur or grouted with cement. A similar method is used sometimes for leveling large floor-plates.

Simple Pillar Feet

The plainest type of machine foot is one that terminates in a round or square pillar, such as is used for a light drilling machine, grinder, or other tool. A foot of this kind is shown at *A*, Fig. 1. An alternative to casting this foot solid is shown by the elevation and plan views at *B* and *E*, respectively. This type of foot affords the choice of a different foot on the same pillar, and enables the manufacturer

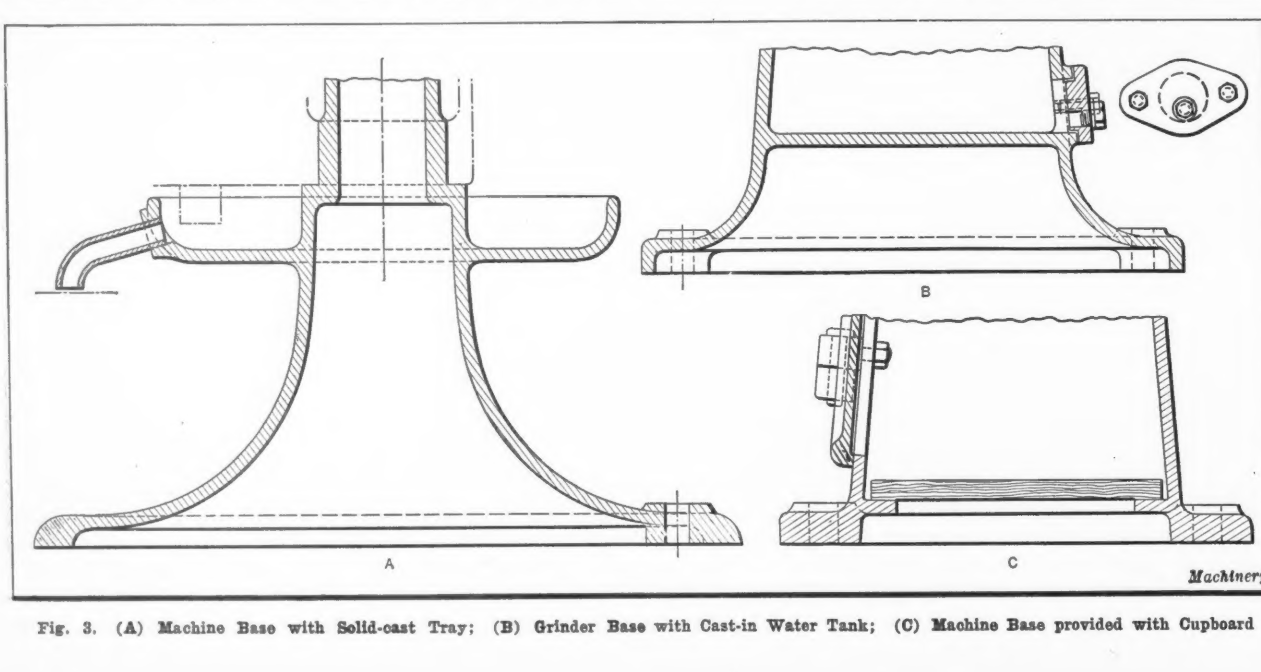


Fig. 3. (A) Machine Base with Solid-cast Tray; (B) Grinder Base with Cast-in Water Tank; (C) Machine Base provided with Cupboard

to arrange a foot for motor drive, or make provision on it for a tank and pump for the coolant. Also there is the occasional advantage of being able to swing the pillar aside to permit placing a long awkward object under the drill, should the shop be rather crowded. A spreading base can also be employed to advantage on portable drilling machines used on floorplates or on a baseplate adjacent to a work-holding table. A machine foot of this kind, which is provided with bolt slots and supports a central stem around which a swinging sleeve is rotated with gears by hand is shown in the view at *D*.

Additions to otherwise simple feet of these types are made for the purpose of carrying a countershaft, motor, tank, or perhaps a treadle or some equipment that forms part of the fixture or work support. An example of a machine foot of this kind is shown at *C* and *F*. This foot has a facing for a countershaft at the rear, and a small round surface or pad for the bracket of a shipper treadle at the front. The only objection to casting the foot and the pillar in one piece, especially if the foot is rather complicated, lies in the risk of fracture in transit or erection. Such an accident is not so likely to occur when the foot is separate, and replacement is also much easier if the foot is cast separate. A solid-cast coolant pan (for a cutter grinder) as shown at *A*, Fig. 3, is not favored by some manufacturers, because there is the possibility that it may be broken while in use. For this reason a separate pan encircling the column, or sandwiched between the foot and the column, is considered preferable.

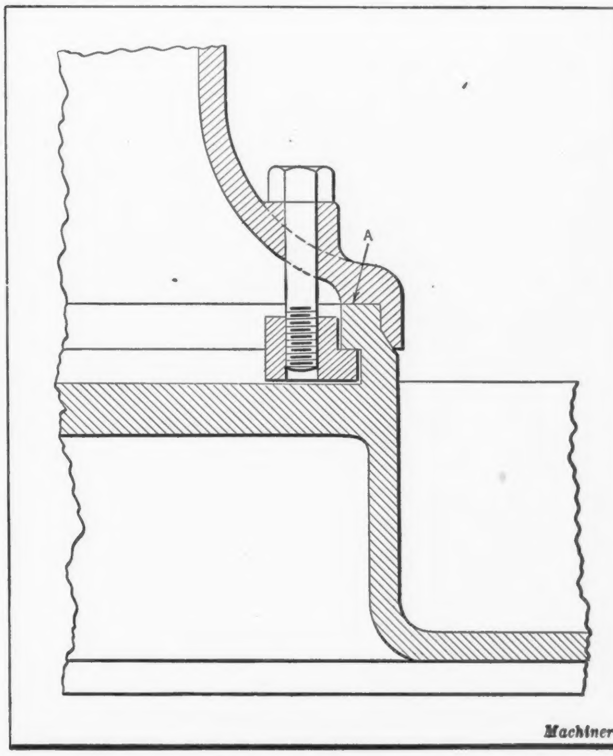


Fig. 4. Machine Foot designed to provide Circular Adjustment of Column

The internal arrangements of a simple column usually do not comprise much in the way of extras; generally a tool storage cupboard is arranged for in the columns of grinders, milling machines, etc. The weakening of the box structure by the casting of the doorway is not so great as it might appear, as the web or ribs put in to hold the shelves (see view *C*, Fig. 3) serve to compensate for any weakness thus developed. Frequently supplementary ribbing is added further up, at intervals, without reference to shelves. In the case of the disk grinder foot shown at *B*, there is no sacrifice of strength, but rather an increase since the web that forms the floor of the coolant tank stretches completely across the cavity in the base, and the only opening is a small gland door with a screw plug to permit the base to be drained or cleaned out.

The foot must be separate from the column in certain machines which are designed to permit the column to be rotated into different positions for convenience in handling the work, or to suit a relative setting of the table and head. The foot may be prolonged upward into a centering and steadying stem, or a facing only may be sufficient for the contact of the two elements, using T-slot bolts, or flanged clamps to hold the parts in position. In a certain type of universal grinding machine, there is an outer column to support the knee that holds the carriage and tables. This column can be swiveled, thus enabling the table to be turned to any position relative to the grinding wheel, which remains in a fixed position. An annular bearing receives the column, which is clamped by bolts with hook nuts, as shown in Fig. 4. A slight motion of a lever brings the roller bearing into action, after the bolts have been loosened, thus permitting the column to be easily rotated. The roller (not shown in the view) bears on the top of the annular bearing surface at *A*.

The loose fitting of a pan around a machine foot, as shown at *A*, Fig. 5, is rather an unusual requirement, the fit being free enough to allow the operator to swing the pan out of

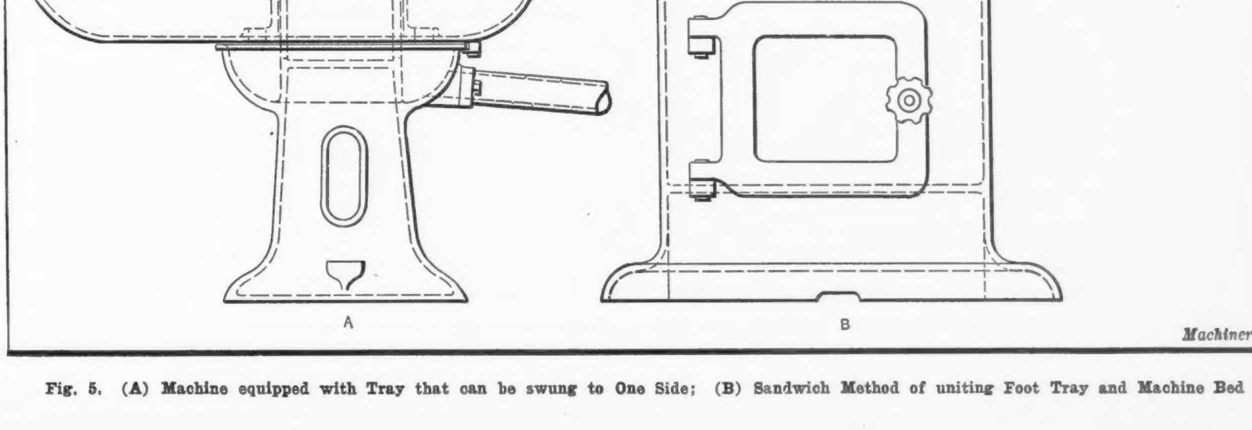


Fig. 5. (A) Machine equipped with Tray that can be swung to One Side; (B) Sandwich Method of uniting Foot Tray and Machine Bed

the way, if the nature of the work demands. This feature is embodied in the design of a broaching machine, where the long side of the pan reaches under the faceplate to catch the chips and coolant, but may be swung aside for deep work or fixtures. When this is done, a pan on the floor, or a special pan just underneath the fixture is used.

A single pillar is utilized for some of the smaller engine lathes, turret lathes, and special lathes having short beds. If a chip or coolant tray is wanted, it may be sandwiched in, as indicated in the view at *B*, Fig. 5, or it can be cast with the foot, or with the bed. The pillar nearly always serves as a cupboard. Some of the turret lathe builders confine the use of the single pillar to the shorter beds, but a few use it for quite long lathes, instead of choosing the alternative of two feet.

* * *

HISTORY OF SPIRAL BEVEL GEARS

Spiral bevel gears and the machines used for cutting them go much further back into history than is generally thought. In 1820 a book was published in Manchester, England, entitled "A Century of New Inventions." In this book spiral bevel gears are described, and it is stated that they were invented in England by James White in 1788. Napoleon presented White with a reward for his invention, and in France spiral bevel gears were often referred to as "White's gears," from the inventor. Around 1825, J. G. Bodmer, a Swiss engineer, working in Manchester, England, cut curved tooth bevel gears to be used as patterns. Samples of these are still in existence.

The next reference that we find to spiral bevel gears is in 1855, when a Frenchman named Deshays took out a patent with many elaborate claims covering a machine for cutting spiral bevel gears. Later Piat exhibited spiral bevel gears at the "Universal Exposition" in Paris. His machine for producing these gears was described in the *Annales Industrielles*, February 4, 1883.

In 1885, a United States patent (No. 330510, dated November 11, 1885) was granted to O'Gorman for a machine designed to cut spur or bevel gears, either straight or spiral. Mr. O'Gorman used an ordinary spur gear rotary cutter, and rotated the blank to produce the spiral shape of the tooth. In 1887 Lindsay and Allen obtained British patents covering a templet machine for planing spiral bevel gears. In this machine the blank was oscillated simultaneously with the stroke of the tool to produce the spiral curve. This machine was used for cutting gears to be used as patterns.

Ten years later, in 1897, Friedrich Stolzenberg & Co., of Berlin, Germany, made certain modifications on a Gleason 24-inch former-type gear planer, whereby it was possible to give the blank an oscillating motion timed with the cutting stroke, and in this way spiral bevel gears were cut on this machine. In the following year, Foote Bros. Gear & Machine Co., of Chicago, Ill., cut spiral bevel gears on a milling machine by the use of a special arrangement.

In 1899, L. F. A. Monneret obtained a patent in France for cutting spiral bevel gears with a generating process. This machine was exhibited in the Paris Exhibition in 1900. The blank rotated continuously, thereby producing the spiral curve during the cutting stroke and affecting the indexing movement to the next tooth during the return stroke. Another machine brought out by Usines Bouhey for producing spiral bevel gears was also exhibited at the same exhibition, in which the blank oscillated in time with the cutting stroke. Both the Monneret and the Bouhey machines were completely described by Fred J. Miller in the Transactions of the American Society of Mechanical Engineers for 1901.

The Wilson-Pilcher automobile in England was provided with spiral bevel gears in the rear axle in 1901, and similar gears were employed in this and in the Armstrong-Whitworth car until 1911. These gears were cut on milling machines provided with special arrangements. In 1905 a U. S. patent was granted on the use of spiral bevel gears in an agricultural seeder. These were cast gears, and have been extensively used by the Peoria Drill & Seed Co., Peoria, Ill. The Buffalo Gear & Pattern Works, Buffalo, N. Y., have also been making spiral bevel pattern gears for many years.

In 1905, F. J. Bostock obtained a patent in England on a hobbing method for spiral bevel gears, but his method was never applied to any appreciable extent in practice. A United States patent was also issued in the same year to K. Knudsen, covering a special arrangement of spiral bevel gears in automobile rear axles. Gears for some of these axles were cut by the Foote Bros. Gear & Machine Co. on a milling machine. A French patent was issued in 1908 to L. Boisard for hobbing spiral bevel gears. The inventor claimed to be able to hob such gears, but the method has never been practically demonstrated, and is deemed impracticable by prominent gear experts.

Citroen gears cut with a double curve and produced with an end-mill have been used in automobile rear axles, and good running qualities are claimed for them. The teeth of these bevel gears required some hand work after cutting. The Wiesengrund and Roberts machine, using the end-mill method, has also been employed abroad in recent years for cutting large bevel gears. The milling cutter is fed across the face of the blank, and at the same time the cutter-carrying member is swung around the axis of the gear blank to produce the desired curve.

In 1910 the Gleason Works of Rochester, N. Y., started to develop an attachment, and later a machine, for generating spiral bevel gears, and in 1912 built a special generator which cut curved-tooth bevel gears, followed in 1913 with the present Gleason spiral type generator, using a face milling cutter. In 1912, the Packard Motor Car Co. began the development of an attachment to the Bilgram generator for cutting curved-tooth bevel gears. This method is similar to that used in the Gleason attachment developed in 1910. In 1912, I. E. McCracken and J. C. O'Brien developed a method and machines for cutting circular-tooth gears in the R. D. Nuttall shops, Pittsburg, Pa. This brings the history of this development up to the point referred to in the article "Hobbing Spiral Bevel Gears" in November MACHINERY.

* * *

FOREIGN TRADE IS AN EXCHANGE OF GOODS

It must be appreciated that the ability of the foreigner to dispose of his raw, semi-finished, or completely manufactured products to us enables him to buy from us the wide variety of foodstuffs and manufactured articles that he may need or desire. In short, the larger the foreigner's sales to us, the greater will be his power to buy our copper, cotton, agricultural products, machinery, automobiles, and innumerable other articles of utility and convenience, in the production of which Americans excel. On the other hand, foreign finished manufactures, imported and sold in the American market, while in some lines competitive with our domestic industries, furnish us with a variety of goods often not produced here.

Imports of raw materials and merchandise are paid for in various ways—chiefly by the export of our own products. The important point, however, is not so much how they were paid for, but that, in 1922, for instance, foreign producers and manufacturers, on account of their sales to us, received money or goods to the value of $3,112,548,000. This not only enabled the foreign producer or manufacturer to pay his labor, finance his business, allow for depreciation, add to his plant, and presumably make a reasonable profit; it did much more. It put him in a position to buy the additional materials—some of them no doubt from us—necessary to keep his enterprise going. Thus both foreign capital and labor were better enabled to satisfy in the American market their needs or desires for those things that we produce in superlative fashion, and that are justly famed throughout the world.—*From "Our Imports and Who Use Them," by the National Foreign Trade Council.*

MACHINERY'S DATA SHEETS Nos. 23 and 24

CUT OUT ON THIS LINE

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Punch-holes are spaced to fit standard loose-leaf ring binders for sale by stationers generally.

PUNCH

HELICAL PHOSPHOR-BRONZE SPRINGS

TABLES FOR CALCULATING HELICAL PHOSPHOR-BRONZE SPRINGS

By JOSEPH H. SULLIVAN, Springfield, Ohio

The accompanying table, Data Sheet No. 24, and the Data Sheets to follow in January and February apply to phosphor-bronze helical springs, and are calculated for a fiber stress of 60,000 pounds per square inch, with a modulus of elasticity of 6,000,000.

The Brown & Sharpe wire gage is the standard used for phosphor-bronze wire, and except where fractional sizes are used in the table, the numbers refer to the Brown & Sharpe gage.

The tables give, in the two left-hand columns, the size of the wire from which the spring is made, both by gage number and in decimals. Along the top of the tables is given the mean or pitch diameter of the spring. To find the values relating to any one spring, therefore, first locate in the left-hand columns the size of wire from which the spring is made, and then follow the horizontal line from this size to the column headed by the mean diameter of the spring. For example, assume that the values for a spring made from No. 5 B. & S. gage, having a mean or pitch diameter of 2⅛ inches, are to be found. In Data Sheet No. 24, the number 5 is located in the left-hand column, and then the lines applying to this size of wire are followed horizontally until the column headed 2⅛ inches is reached. Here we find three values given, one above the other, as follows: 64.0, 0.780, and 82. The *top value* gives the load, in pounds, required to compress the spring solid, or the total capacity of the spring. In this case 64 pounds would be required for this purpose. The *second value*, 0.780, gives the movement per coil, in inches, when the spring is compressed from its free height to solid; this value also often is known as "deflection under total load per coil." In this case, then, the deflection under a load of 64 pounds is 0.780 inch per coil. The *third value*, 82, is a "load-compression value." If this value is divided by the number of working coils in the entire spring, the load, in pounds, required to compress the spring 1 inch will be found.

The third column from the left in the table is headed "Constant." If this constant is divided by the pitch diameter of the spring, the quotient will represent the load that will compress the spring solid. This constant is used in cases where the pitch diameter of the spring is not found directly in the table, but is a value intermediate between those given at the top of the columns. For example, assume a spring having a pitch diameter of 2 1/16 inches, made from No. 7 B. & S. wire. The load that will compress this spring solid is $70.4 \div 2\ 1/16 = 34.1$.

Example 1—A spring is made from No. 4 B. & S. gage phosphor-bronze wire. It has a mean diameter of 2¼ inches and 10 working coils. What weight is required to compress this spring 1 inch? By referring to Data Sheet No. 24, it will be found that for a spring of the size wire and mean diameter specified, the value in the third line is 115, which, if divided by the number of working coils (in this case 10), gives a weight of 11.5 pounds as required to compress the spring 1 inch.

Example 2—A spring is made from No. 6 wire and has a mean diameter of 2 inches. How many coils are required in this spring to obtain a movement of 1 inch with a load of 10 pounds?

By dividing the value 64, found in the third line in the table, by the load (10 pounds) the number of working coils required is found in this case to equal 6.4.

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HELICAL PHOSPHOR-BRONZE SPRINGS

Size of Wire, B. & S. Gage	Diam. of Wire, Inches	Constant	Mean or Pitch Diameter of Spring, Inches									
			2⅞	2¾	2⅝	2½	2⅜	2¼	2⅛	2	1⅞	1¾
			128	134	140	147	155	164	173	184	196	210
¼"	0.2500	368	1.039	0.950	0.866	0.786	0.709	0.636	0.568	0.503	0.442	0.385
			123	141	162	188	218	257	305	366	445	550
			93.5	97.0	102.5	107.7	113.2	119.0	126.5	134	143	153
3	0.2253	269	1.153	1.055	0.961	0.871	0.787	0.706	0.630	0.558	0.490	0.427
			80	92	107	125	144	164	200	242	291	356
			85.8	90.0	94.0	98.6	104	110	116	123	132	141
7/32"	0.2187	247	1.190	1.085	0.990	0.896	0.856	0.727	0.649	0.574	0.505	0.440
			71	82	95	110	128	151	179	217	265	325
			....	73	77	80	85	89	95	100	107	115
4	0.2043	201	....	1.163	1.060	0.961	0.864	0.779	0.695	0.615	0.540	0.471
			....	63	70	84	98	115	137	163	198	244
			....	56	59	62	65.4	69	73	77.6	82.3	89
3/16"	0.1875	155	....	1.268	1.155	1.048	0.945	0.848	0.757	0.670	0.592	0.513
			....	45	51	59	69	81	97	115	140	173
			....	49.4	51.8	54.4	57.2	60.4	64.0	68.0	72.5	77.7
5	0.1819	136	....	1.427	1.189	1.084	0.974	0.874	0.780	0.690	0.607	0.529
			....	35	46	53	61	72	82	100	124	147
						40	42.1	44.5	47.1	50	53.3	57.0
6	0.1620	100	See Data Sheet No. 23 for directions for use of table.			1.202	1.096	0.980	0.876	0.776	0.682	0.594
						33	39	45	54	64	77	96
						28.2	29.7	31.3	33.1	35.2	37.5	40.2
7	0.1443	70.4				1.360	1.228	1.100	0.983	0.868	0.766	0.667
						21	24	29	34	41	50	60
			....	....	....	19.6	20.6	21.8	23.1	24.7	26.1	28.0
8	0.1285	49.4	....	....	....	1.524	1.380	1.240	1.104	0.980	0.860	0.749
			....	....	....	13	15	18	21	25	31	37

The British Metal-working Industries

From MACHINERY's Special Correspondent

London, November 17

MANUFACTURERS in most parts of the country now appear to be showing more faith in the improvements in trade that have been noticeable for some time. They know now what costs will be incurred in an undertaking, and also that orders are to be obtained only in the face of keenest competition. In the metal-working field, the industries that are working to capacity are few and far between, and generally these exceptions are due to the influence of the automobile industry.

Conditions in the Machine Tool Industry

In the machine tool industry the activity varies considerably with the district. In the Birmingham area a decided improvement has been noticeable for some weeks, and the demand for skilled labor is growing. At least two well-known firms are running at full capacity. The smaller machines, especially those of the manufacturing type, are in greatest demand, including small turret lathes, and milling and drilling machines. Simple types of grinding machines are also being called for. Textile manufacturers show considerable interest in turret lathes, and the electrical trades are taking a fair proportion of the output of the simpler standard types of machine tools.

In the Yorkshire district, firms who manufacture a large variety of machine tools are generally in a better position than those who specialize on one type. Some of the latter, however—notably makers of 13-inch lathes—are busier than they have been for a long time. Scottish machine tool makers, who have been among the most pessimistic during recent months, are at last reporting an improvement. Inquiry comes mainly from local industries. One large maker in Govan has a number of standard drilling and tapping machines, and also special lathes on order. In the Lancashire area several firms report an increasing number of orders in hand, including gear generators, special machines, jigs and fixtures, screw machines, and slotters.

Overseas Trade in Machine Tools

During September the exports of machine tools were practically equal, in both tonnage and value, to the exports during August, being just over 1000 tons, with a value of £106,000. There was a curious drop in the value per ton of imports in September, the figure falling from £147 in August to £108 in September. The value per ton of exports remained at about £100 to £105.

The export value of small tools, milling cutters, etc., rose in September to £156,765, which was more than double the corresponding figure for August. Lathes contributed by far the largest proportion to the value of exports in September, and for that month the imports of lathes were also greater than for any other machine tools.

Shipbuilding

The immediate prospects in the shipbuilding industry are dependent largely on the outcome of the boilermakers' lock-out. The lock-out has now been in force for twenty-seven weeks, and has involved a loss estimated at £7,000,000. Although at the moment conditions are deplorable on the Clyde, reports generally indicate that there is a good deal of shipbuilding work in prospect, and actual orders have recently been placed at several yards.

According to Lloyds' Register the total tonnage of merchant ships afloat at the end of June was 28,208,206 tons, of which over 50 per cent is British-owned. Although this figure is the highest on record, many of the vessels included are for various reasons unlikely to be put into service again even in the event of a substantial trade revival, while the elimination of obsolete tonnage is likely to exceed new production considerably if the present meager scale of building continues.

Railway and General Engineering

Among private locomotive building firms, it was anticipated that the absorption of all the smaller railway companies into the larger concerns who have well established locomotive shops of their own, would result in a considerable loss in home business. The first substantial move, however, on the part of the London & North Eastern Railway to increase the number of locomotives will necessitate a portion of the orders being placed with outside firms. It has been decided to spend as much as £1,250,000 on new locomotives, and the urgency of the requirements places them beyond the capacity of the company's own shops. In addition £2,500,000 is to be spent by the same company on new cars, and the directors have decided on a liberal policy of track renewal. The London Midland & Scottish Railway Co. has decided to spend £4,000,000 on current work and to place orders amounting to £10,000,000. The expenditure is to cover new rolling stock, locomotives, repairs, and constructional work. In addition, a good deal of car construction is in hand for overseas destinations.

There is good demand for the smaller powered gasoline-paraffin engines, but makers of the larger types up to 400 to 500 horsepower are not very busy. Builders of steam engines and condensers have more work in hand. Textile machinery makers are not receiving as many orders for the East as they have been in the past, but they have had such a busy time during a period of general slump that the industry is in a very good position. The activity among the manufacturers of larger electrical equipment continues, and the outlook for the electrical engineering industry in most of its branches is satisfactory.

Labor Conditions

In September, the general condition of employment throughout the engineering industry was officially characterized as bad. The seasonal decline in the activity of automobile works was a contributory feature, and the further depression of marine engineering had a marked effect. The Government's action in furthering road-making schemes has reduced the apparent number of unemployed in some districts, and emigration, particularly from the Clyde area, is another secondary cause of reductions in the number of idle men. The total number of registered unemployed in general engineering in September was 175,209.

Employment in the iron and steel industries was moderate in September, but in the tinplate and sheet-steel trades it remained comparatively good. A serious difficulty, and one that is cumulative, is the scarcity of skilled workers in a large number of industries. A lack of apprentices, emigration of highly skilled men, and the lack of employment that has driven the higher grade men to other industries, have all had a serious effect in depleting the supply of skilled workers. It is felt that the engineering industry will have to take some drastic steps to improve matters if it is to take advantage of improvements in general trade as they occur. The value of the skilled worker must be recognized and met by proportionately high wages and a liberal policy toward training.

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DEFINITIONS OF GEARING TERMS

April, 1922, MACHINERY contained an editorial headed "The Definition of Dedendum," in which was emphasized the importance of clearly defining the meaning of the terms used in gear design, and the activity of the American Gear Manufacturers' Association in the definition and standardization of terms used in gearing was also referred to.

At the 1923 fall meeting of the association, reports were submitted defining every important term used in connection with gearing. In many cases these terms have been accepted, as defined, for many years past, and the work of the committee merely places the stamp of approval upon common practice; but in other instances there have been no commonly accepted definitions, and the committee makes it possible in future to use such terms with the assurance that the meaning has been defined by an authoritative body of manufacturers working in conjunction with the American Society of Mechanical Engineers and the American Engineering Standards Committee.

As a specific example, it may be mentioned that the meaning of the term "dedendum" is now definitely settled. In the past, some manufacturers and some books of reference have defined "dedendum" as "the distance from the pitch circle to the root of the tooth," thus including the clearance allowed at the root; others have used the term as meaning "the distance from the pitch circle to the clearance circle."

The committee of the American Gear Manufacturers' Association now gives the following definition: "Dedendum is the distance, normal to the pitch surface, from the pitch surface to the bottom of the tooth space." Nothing could be more definite, as this can be interpreted in but one way.

Work of this kind is to be highly commended, and when all the terms used in gearing are thus defined, it is possible to use what might be called a common language in speaking and writing about gearing problems. The complete list of authorized definitions will be published in January MACHINERY.

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MACHINE TOOL CANCELLATIONS

When the curve of industrial activity begins to fall, machine tool builders are usually faced with the cancellation problem. Buyers cannot cancel their orders or contracts for pig iron or steel, but there is a prevailing theory that machine tool orders can be cancelled at will, which is altogether inequitable.

An order for a machine tool is as legal a contract as one for pig iron, steel, or other material; and the only reason that buyers disregard their obligation under the latter contracts is because the iron and steel companies will enforce their rights in the courts, if necessary, while most machine tool builders prefer to stand a loss rather than to take legal action against their customers.

Legal action would seldom be necessary if machine tool builders generally took a firm stand on the cancellation question. In the latter part of 1920 one well-known machine tool builder refused to accept cancellations, and found it quite practicable to settle all differences with customers amicably, primarily because the justice of his position was recognized.

Sometimes, and particularly in the building of special machinery, the customer does not actually cancel the order, but requests suspension of work until some future date. If considerable work has already been done on a suspended order, this request means that the machine tool builder is asked to act as banker for his customer, as he ordinarily is not paid until the contract is completed. The manufacturer above referred to, required that in all cases of suspended work payment be made within a reasonable time for all the work completed up to the date of suspension. He also required a revision of the original price agreed upon for filling the order, because when work is suspended and resumed after a lapse of months, the cost of building the machinery is greater, as starting the work again involves additional expense and loss of time. Often new men have to be broken in on the work, and there are unavoidable delays while they become familiar with its details.

Every fair buyer will recognize the justice of these claims, and once payment for them is established as a custom, buyers will concede them willingly.

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TRAINING SHOP EXECUTIVES

Few papers read before a convention of manufacturers have aroused more interest than that of John P. Kottcamp before the American Gear Manufacturers' semi-annual convention in October last. Mr. Kottcamp emphasized the necessity of carefully selecting and training shop foremen, and dealt specifically with two problems: (1) How to select men who appear to have the necessary qualifications for becoming good executives; and (2) what special inducements should be offered, so that men with the required qualifications will consider it worth while to acquire the training.

In his paper Mr. Kottcamp described a course of training that he believed would produce the best all-round shop executives. First, a boy should graduate from high-school; second, for one or two years he should enter a shop where he could become thoroughly familiar with the general methods and principles of mechanical work; and, third, if he then has proved his fitness for such work, he should take an intensive two-year course of instruction, devoid of all unnecessary "frills," such for example, as is provided by the Pratt Institute in Brooklyn, N. Y. Then the student returns to the shop for continuous work, and experience has shown that in a few years he usually will develop qualifications that are of great value in a shop organization.

There is no method which can truly be described as the "only way" by which successful shop executives can be trained. No amount of training will make good executives of some men; others are born with the talent for organization and direction. There is great need for more systematic training, not only of those who are to constitute the rank and file of machine shop workers, but also of men who are to occupy more important positions. Every practical effort to solve this problem is helpful, and the more thought is given to it the sooner will these efforts result in definite action, so that specific means will be provided for the training of such men.

As yet there are too few institutions that offer courses particularly intended for the training referred to above. The ordinary trade school, intended, as it is, primarily for the training of shop workers, does not and cannot go far enough. The engineering college is intended for the training of engineering leaders and designers rather than shop executives. But gradually, as the need for intermediate training institutions is recognized, the present trade schools can be extended in scope so as to provide two-year training courses for foremen and shop executives; or entirely new schools can be equipped to take care of this urgent need.

Development of the Gear Industry*

Importance of Finding New Uses for Gearing, and Examples Illustrating Possibilities

By E. W. MILLER, Chief Engineer, Fellows Gear Shaper Co., Springfield, Vt.

THE object of the following is to emphasize the advisability and probable necessity of a painstaking inspection of all factors influencing the gear industry. With a definite knowledge of conditions as they are and the belief in the possibilities of growth, every effort should be made to obtain the fullest development. Whenever gears may be avoided to the betterment of a device we manufacturers of gears and gear-cutting equipment should readily assent, for it is good business always to assist in and insist on the design most satisfactory to maker and user. When gears are of value we should be alert to prove their worth. A business such as the gear industry is invariably brought into being by a demand for a product. As the demand increases, the business grows apace. It is characteristically human to accept such business as comes to hand, to enter the field competitively and through advertisement and a corps of salesman and service experts, to secure a maximum of desirable business. It is indeed uncommon to find in a mechanical institution a department whose purpose is business research engineering. The office of such a department would be not only to explore the present gear field with painstaking determination, but also to ascertain accurately to what new uses gears may be put, thus bringing out the potential possibilities.

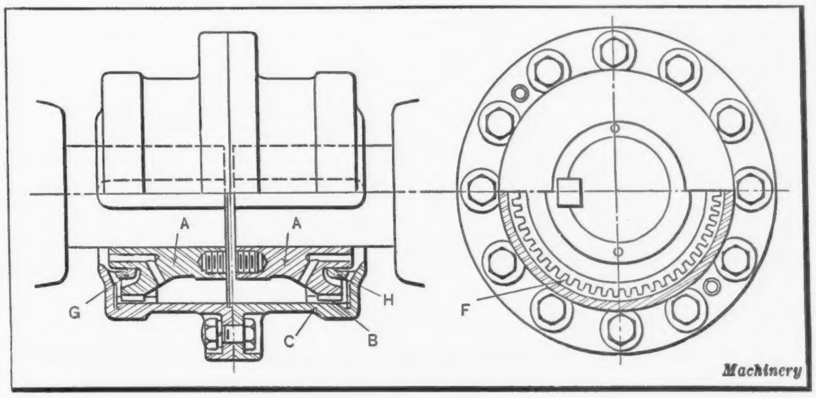


Fig. 1. Shaft Coupling provided with External and Internal Gear Teeth

There are certain possibilities at present largely unconsidered which even superficial observation makes plain. For example, consider the substitution of cut gears for those now having the teeth cast or punched. Not only is the cut gear a great improvement with respect to quietness and smoothness of operation, but it can also be demonstrated that the manufacturer can produce gears more cheaply by cutting than otherwise. Expense of assembly and hand work on the teeth may far exceed cutting costs. It is the business of manufacturers first to investigate and then demonstrate if we would fully develop our industry.

Thousands of toothed wheels are being made today that cannot receive the approval of gear engineers. History is behind these tooth designs. It is usually found that some mechanical genius has worked out a device experimentally. Cut-and-try methods have resulted in notched wheels which cause the mechanism to work satisfactorily. A market has been developed, and the gear teeth are patterned after those in the experimental machine. In many instances a great business has developed from the machine that carries these toothed wheels of uncertain identity. Special machinery is developed for the production of these gears, and they are made in great quantities.

Analysis makes plain that these primitive gear tooth shapes are expensive members. The lack of gear knowledge on the part of an otherwise able designer and mechanic results in waste of money. The tooth design is such that production cannot keep pace with the development of gear-cutters and gear-cutting machinery. A change is unthinkable because of difficulties in supplying repair parts. Here is plainly our opportunity. We should to the full limit of our resources get into touch with new design work, and then without presumption but with a sincere desire to solve the problem for the best interests of all concerned, offer our best engineering advice. It is here suggested that when possible (and it will be in most cases) a tooth shape be recommended which may be readily produced on up-to-date machinery, commonly available.

In our everyday thinking of gear teeth the idea of motion is ever present. "Gear tooth action" is a common expression. There is a possibility, however, that the future may show the value of gear teeth for power transmission when little or no motion occurs between engaging teeth. Gear teeth may become prominent as the chief members in a liquid measuring device, actually doing the measuring while other teeth in common fashion effect the rotation of the mechanism. Gear teeth may occupy an important place in the great refrigerating industry now so rapidly developing. As compressors they may take their place in the multitude of large and small chemical refrigerators which will be in use within a few years. Gear teeth, in addition to being transmitters of power, may be a part of the prime mover. The air turbine whose rotor carries gear teeth may become widely used. Gear teeth may be used as a positive face clutch. No doubt there are many other possibilities. Evidently it should be the office of a business research engineer to explore the field thoroughly.

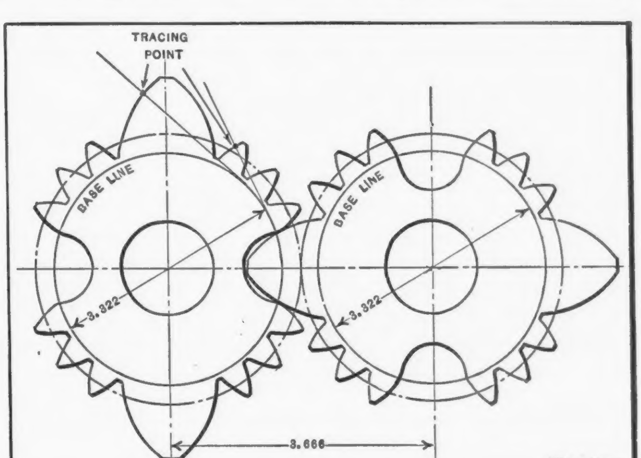


Fig. 2. Pump Impellers having Tooth Curves all developed from the Same Base Circle Diameter

Shaft Couplings Having Gear Teeth

Couplings whose office is to join shafts with center lines in approximate alignment, thus effecting the posi-

*Abstract of a paper presented before the American Gear Manufacturers' Association.

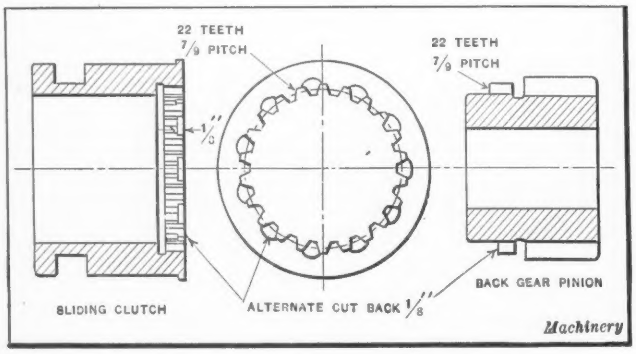


Fig. 3. Positive Clutch which may be engaged in Twenty-two Different Positions

tive transmission of power from one shaft to another, are devices familiar to mechanical men. When much power is transmitted, and especially when the coupling is subjected to shocks as is the case in steel rolling mills, the design and manufacture require close attention. Fig. 1 shows a coupling of unusual design recently developed by Gustave Fast of Baltimore, Md., which is now being manufactured by the Bartlett Hayward Co. of the same city. This coupling transmits power through the engagement of external and internal gears having an equal number of generated involute teeth. The hubs *A* are keyed to their respective shafts as shown, and each carries an external gear at the extremity farthest from the shaft end. The surrounding casing *C* carries two internal gears which engage the external gears. Thus the teeth of the engaging gears act as so many keys for the transmission of power. These teeth are plainly shown at *F*. Controller rings *G* and *H* positively locate casing *C* with respect to the center of the shaft which carries the engaging external gear. It is obvious that teeth of various shapes might be employed for this coupling if it were possible to produce them easily. It appears, however, that these involute teeth can be cut cheaply and accurately, and that these keys are more easily produced as involute teeth than as other shapes. This, then, is a new use of gear teeth, and is an example of power transmission with extremely limited motion between the teeth of the engaging members.

Pump Impellers as an Example of Special Gear Engineering

The impellers of a pump built by the Saco-Lowell Shops of Lowell, Mass., are shown by the diagram Fig. 2. The pump is driven by a shaft which is keyed to one impeller. The outer extremity of this shaft carries a gear which, engaging an equal gear on another shaft, effects the rotation of the second impeller. Each impeller is a close running fit in its bore, and the small teeth act as a seal against escape of the liquid. While the sealing effected by the small teeth might be accomplished otherwise, it is doubtful if any other means would be as effective and long-lived. These impellers are of bronze and formerly were cast. Recently the maker has employed cut teeth, thereby about doubling the pumping capacity and appreciably reducing the cost of production.

The gear engineering connected with this impeller is of interest. The diagram indicates a center distance of 3.666 inches. Since the impellers are equal, the pitch diameter is 3.666 inches. All of the teeth have been developed from a common base line, 3.322 inches in diameter, the curve of the large teeth being a continuation of the curve used for

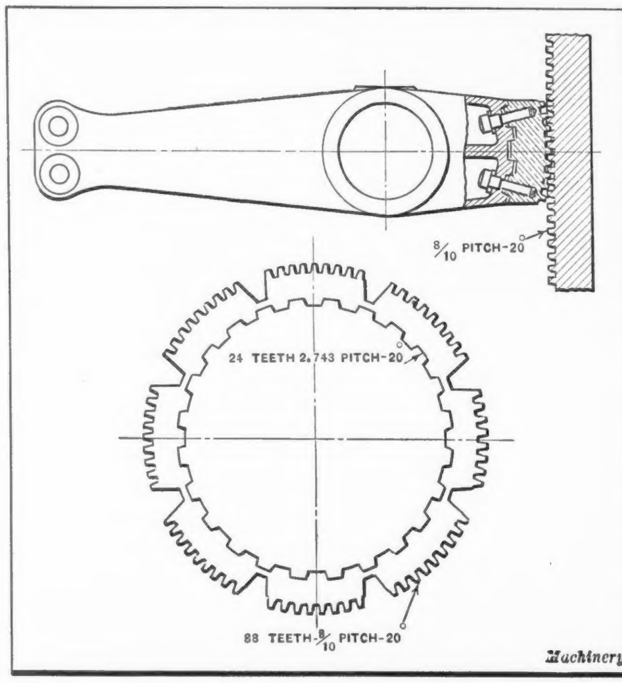


Fig. 5. Method of holding Gear Segments by Means of Gear Teeth instead of using Keys

the small teeth. With careful attention to design and production, these gears may be run together properly without the influence of outside control. This is a striking example in the use of different portions of involute curves developed from a common base line.

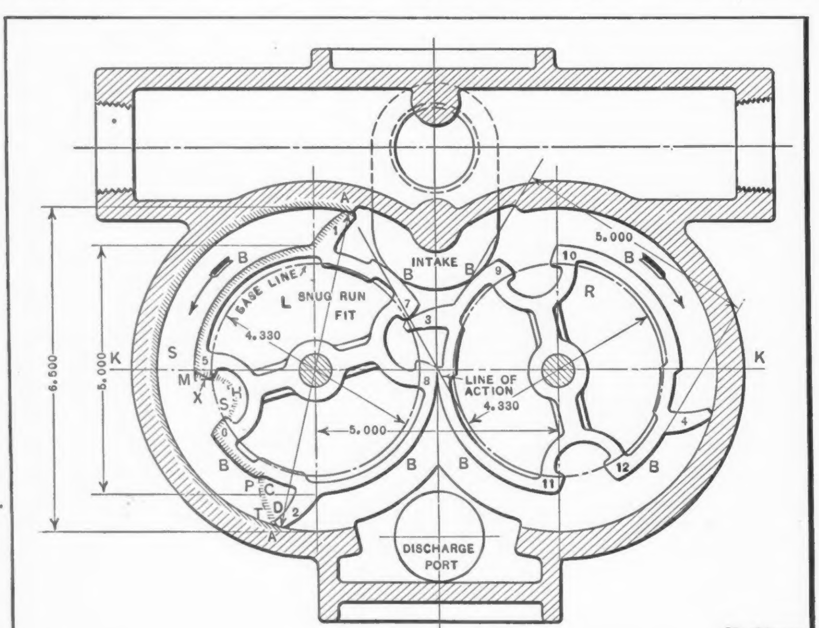


Fig. 4. Liquid-measuring Device representing an Interesting Gear Problem

Positive Clutch Having Twenty-two Involute Teeth in Engagement

A positive multiple-tooth clutch as originally made and used in one of the machines of the Hendey Machine Co. of Torrington, Conn., had six teeth with only six possibilities of engagement. The shock of the pick-up was taken on three surfaces, since alternate teeth were cut away to permit easy engagement. The teeth were cut on a milling machine, which required an operator to effect the indexing from tooth to tooth. It was believed that this arrangement was too expensive and that some other design would prove more serviceable.

Careful attention to the matter resulted in the design indicated in Fig. 3. The sliding clutch carries twenty-two internal involute teeth of 7/9 pitch, 20 degree pressure angle. The back-gear pinion has a corresponding number of external teeth so sized as to easily enter the internal gear. With this new clutch there are twenty-two opportunities for the

teeth to enter in each revolution of the driving member—a great operating advantage. Each alternate tooth is cut back 1/8 inch to permit easy engagement. The pick-up is taken on eleven surfaces, which means longer life, and since the clutch teeth are produced on automatic machines, several of which are handled by one operator, the production cost has been greatly reduced. The particular clutch shown transmits 10 horsepower at 200 revolutions per minute.

Involute Curves Applied to a Liquid-measuring Device

Fig. 4 indicates a section through a liquid-measuring device designed and built by the S. F. Bowser Co. of Fort Wayne, Ind. The purpose of this machine is to measure accurately and rapidly a liquid which is drawn in through the opening marked "intake" and expelled at the place marked "discharge." Two rotors, *L* and *R*, mounted on parallel shafts exactly 5 inches apart, pump the fluid and at the same time accurately measure it. In order to effect this, it is important that the shaft center distance, the bore

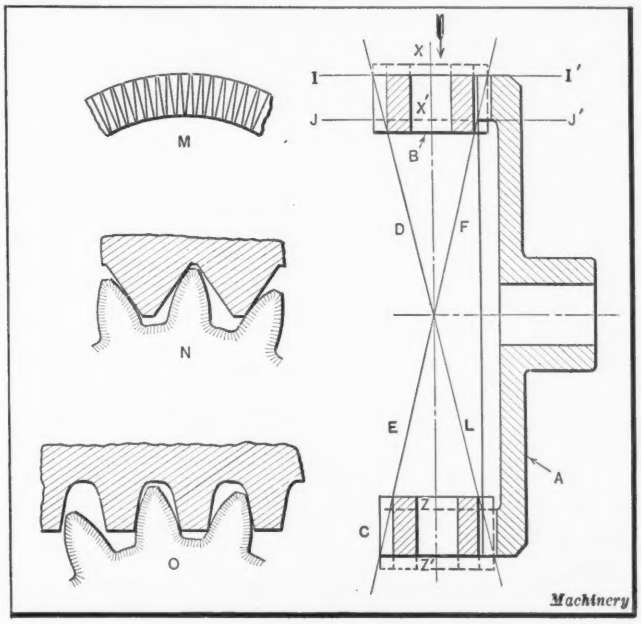


Fig. 6. Face Gear Type of Right-angle Drive

in the housing, and certain surfaces of the rotors be finished most accurately, and extremely small limits of tolerance are established to this end. The mechanism is operated by a hand-crank mounted on the right-hand shaft. A pair of precision spur gears of equal size are mounted and keyed to the two shafts. As the crank rotates one rotor, the gears assure equal rotation of the other.

Two long, unsymmetrical, involute teeth indicated by numbers 1, 2, 3, and 4 project from each rotor. These teeth are diametrically opposite, and are sized at their outer extremities to a snug running fit with the bore of the housing. There are also four other involute surfaces on each rotor. They are numbered 5, 6, 7, 8, 9, 10, 11, and 12. The surfaces *B* are cylindrical, and are held to the exact diameter of 5 inches. The pitch diameter is 5 inches. All involute surfaces are developed from a base-line diameter of 4.330 inches. The pressure angle is 30 degrees. In the position shown, involute 3 of rotor *R* is in final contact with involute 7 of rotor *L*. Further rotation will break contact. Surfaces *B* have just come into contact, and provide an effective seal against passage of fluid between the rotors as projections 2 and 4 approach each other, positively forcing the fluid through the discharge port indicated. Involutes 1 and 2 are in such position that their extremities are in contact with the bored portion of the housing. They have so impounded the liquid that it cannot escape until further rotation brings 2 out of contact with the bore. Then further rotation permits involute 1 to drive most of the fluid carried between 1 and 2 through the discharge port.

The area of space *S* (bounded by the bore of the housing, the projections 1 and 2, and the remaining outline of the rotor) multiplied by the depth, establishes the volume of the liquid carried between the projections. This, however, does not determine the exact capacity of the pump. As involute 2 reaches the line of centers *KK* it engages involute 11; involute 12 just clears projection 2, its path being the dotted line *PT*. At *P* the cylindrical surface of the two rotors make contact, effecting the seal. As projection 2 passes the center line, the fluid in the area bounded by *PT* and *CD* passes between the rotors and is not forced out through the port. The dotted line *MS* defines the sweep of involute 4 as it engages involute 6, indicating the volume displaced and driven through the port. Volumes *X* and *H* pass between the rotors as in the case of the liquid bounded by *PT* and *CD*.

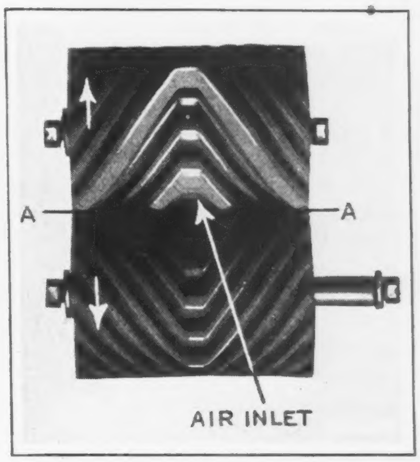


Fig. 7. Air Turbine Rotor

It is not necessary that surfaces 5, 8, 9, and 12 be involutes, but it is of vital importance to have them alike on all rotors, insuring not only interchangeability but identical capacity. Involute surfaces are more easily produced than other accurate tooth surfaces. Hence the use of the involute here. The proper performance is dependent upon several generated surfaces, namely, the bore of the housing, the involute, and the cylindrical portions of the rotors. The capacity of this measuring device per revolution of the rotors equals four times the volume of the space bounded by the shaded lines, since there are two rotors and each is two-lobed. Gear engineering has here solved a difficult problem and advanced the gear standard.

Gear Teeth Substituted for Keys

The office of the rocking arm shown in Fig. 5 is to reciprocate rapidly the rack with which it is engaged. By reason ot its speed, minimum weight is desired. Therefore a tough aluminum alloy is employed. However, it is necessary to use bronze for the gear segment and the latter must be rigidly fastened to the arm. This has been most satisfactorily accomplished by machining a complete bronze ring, and then cutting twenty-four internal teeth of 2.743 diametral pitch. The tooth depth is approximately 1/8 inch. Corresponding external teeth are cut in the operating arm. When sector and arm are clamped together as shown, the teeth act as excellent splines. The lower diagram shows the cast bronze ring. When both the internal and external teeth have been generated, the ring is cut through at the

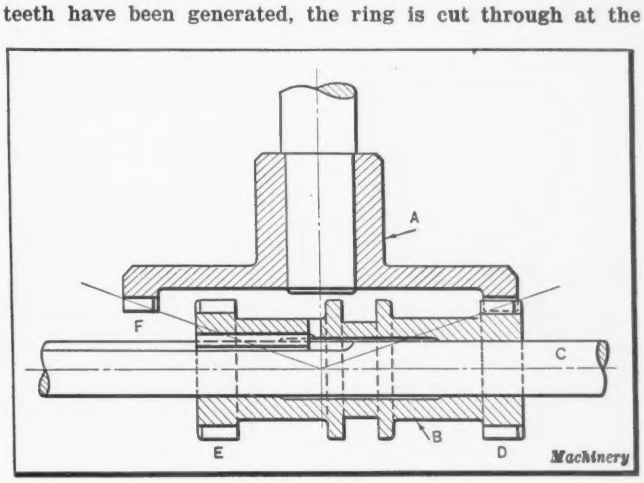


Fig. 8. Reversible Face Gear Drive with Sliding Double Pinion

eight light sections, thus furnishing eight segments. The threaded holes shown are then jig drilled and tapped, and the parts are ready for installation. The employment of gear teeth here has proved much cheaper and more satisfactory than an earlier design which made use of the conventional key for fastening the sector to the arm, requiring that the segments be produced singly.

Rotors of Gear-tooth Type for Air Turbine

Fig. 7 indicates a pair of rotors that constitute the only moving parts of an air turbine built by the Sullivan Machinery Co. of Claremont, N. H. These rotors carry involute helical gear teeth, and are disposed as herringbone gears with a short-faced spur gear between them. In a plane of rotation these spur gears correspond exactly to the helical members. The gears run at pitch line AA. Air is admitted between the teeth through a small hole in the casing. The flow is cut off as the gears revolve, but the air expands until

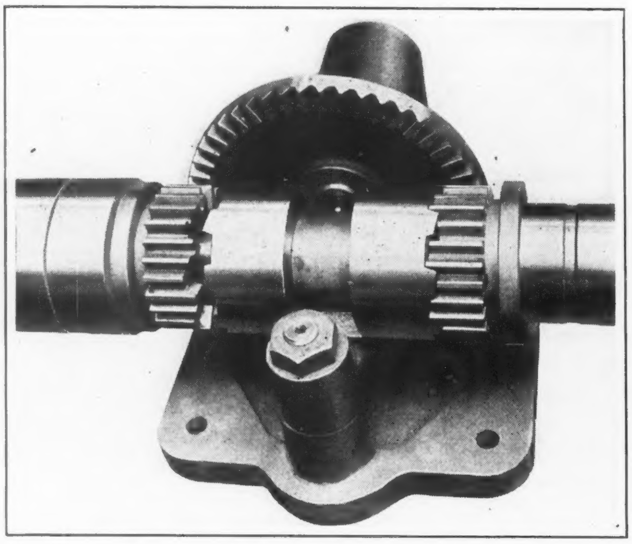


Fig. 9. Reversible Face Gear Drive controlled by Clutch

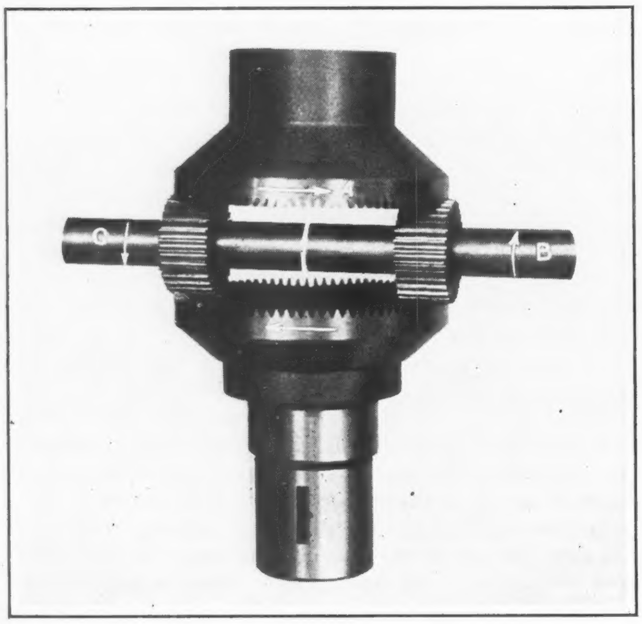


Fig. 10. Double Face Gear and Pinion Drive

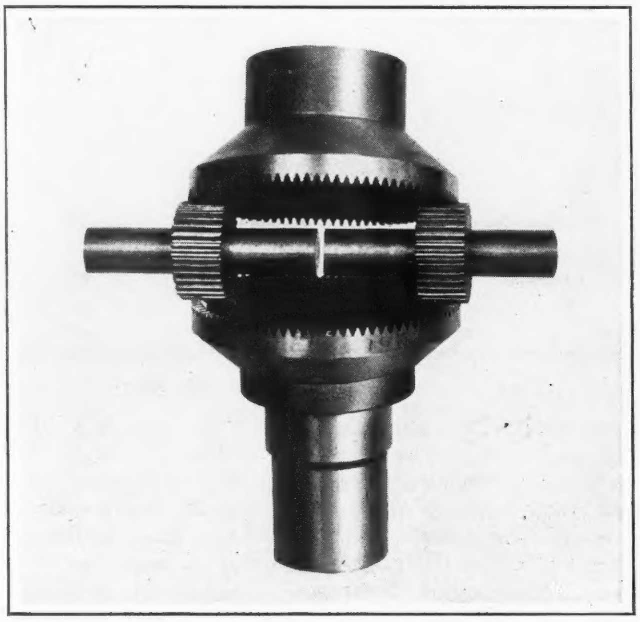


Fig. 11. Possible Arrangement for Shafts that are not in Alignment

the ends of the teeth run out of engagement. As the gears turn, the pockets between the teeth, where air is admitted, correspondingly lengthen, allowing the air to expand several times before it is released. This turbine, known as the "turbinair motor" is an efficient prime mover, and represents another use for gear teeth.

Face Gears for Right-angle Drives

Fig. 6 illustrates a type of gearing recently developed, which is of interest not only by reason of its peculiar tooth design, but also because its application solves certain right-angle drive problems most economically. Gear A is known as a "face gear." The teeth are cut on a face at right angles to the axis of the gear. They are produced by a cutter provided with involute teeth corresponding in number and outline to the teeth in the gear or pinion that is to mate with the face gear. The cutter and work are geared to rotate in the ratio of their respective teeth, and as the cutter reciprocates in contact with the work teeth are developed in the face gear by the molding-generating process.

In order to operate properly with the face gear, the axis of the mating pinion must be located at exactly the same distance from the face of the gear as the axis of the producing cutter. Lines DF, EL, and FL indicate the operating pitch cones of the engaging members. If the pinions B and C are moved to positions indicated by dotted lines XX' and ZZ', the pitch cone position is unchanged, but proper tooth action is obtained, regardless of the axial position of the pinion, assuming, of course, that it is not moved out of engagement. This is an important point since cone adjustment may be disregarded. Diagrams N and O indicate sections at II' and JJ' viewed in the direction of the arrow. It is plain that the profiles and proportions of the pinion teeth are identical in each case. The teeth of the face gear differ much in the two views. At O they have a pressure angle of 10 degrees, and at N the pressure angle is 35 degrees. These angles indicate the extremes. Viewed in this way the teeth are practically straight-sided, being much like involute rack teeth. Diagram M shows the face gear teeth as they appear in the end elevation. These gears are particularly adapted to ratios of 3 to 1 and higher. Drives of 1 to 1 ratio are unsatisfactory, since the active face width is too limited.

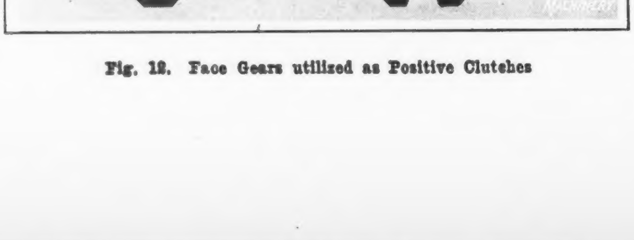


Fig. 12. Face Gears utilized as Positive Clutches

Reversing Mechanisms of the Face Gear Type

An interesting application of the face gear is shown in Fig. 8. The double spur pinion B, mounted on and keyed to shaft C, may be moved along its axis, thus engaging

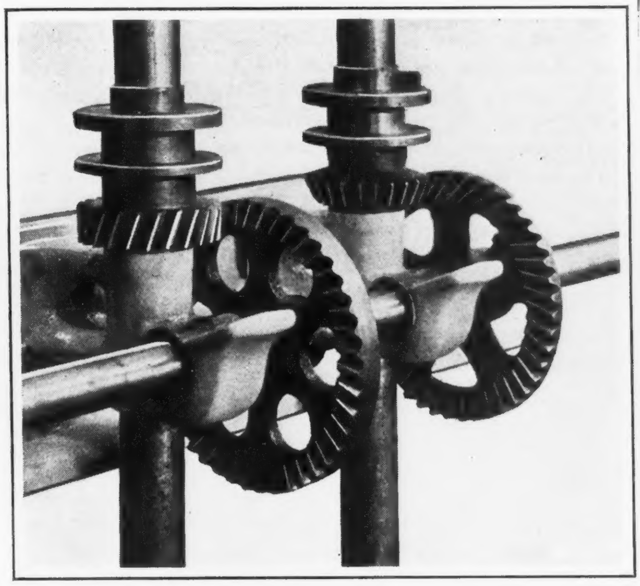


Fig. 13. Offset Type of Face Gearing at Left used in Place of Cast Skew Bevel Gears at Right

the face gear with step D as shown, or step E with the face gear at F. This is an economical and substantial means of reversing the direction of rotation.

Fig. 9 makes plain the use of the face gear for reversing the feed of a machine tool. This mechanism has proved most serviceable, and the arrangement has greatly decreased cost and assembly difficulties. This view shows clearly the appearance of the face gear teeth.

Fig. 10 shows two face gears of equal size, pitch, and number of teeth, engaging a pair of identical pinions. Each pinion corresponds in number of teeth, pitch, and tooth profile to the cutter that produced the face gear. The particular object of this illustration is to show some of the possibilities of the face gear used in conjunction with the spur pinion. When shaft B rotates as the arrow indicates, the other members rotate in the direction of their respective arrows. This shows the possibility of reversing the direction of the shaft rotation through the medium of the face gear. It also makes plain the possible transmission of power to members whose axes are at right angles to shafts B and C and whose directions of rotation are opposite. In Fig. 11 the upper gear is inclined so that its axis is at an angle with the axis of the lower face gear. This illustrates a degree of flexibility in this type of drive.

Face Gear Utilized as a Positive Clutch

The two face gears shown in running action with the pinions of the two preceding illustrations are shown in Fig. 12 mounted face to face on the same shaft. At the right they are separated; at the left they have been pushed into engagement. When thus engaged, the teeth fit very nicely, assuring maximum surface contact. It is apparent that this type of gear, which operates smoothly with the pinion as previously illustrated, may be used without change as a most satisfactory positive face clutch. There are many possibilities of engagement, which is a most desirable feature when used in certain mechanisms. This clutch has a pronounced centralizing tendency, which is also an advantage. This represents an application of gear teeth to power transmission with no movement between the engaging teeth.

Skew Bevel Gears Replaced by Face Gears

A fly frame is a type of machine much used in the textile industry in the first spinning operations. It is the office of the "flyer," mounted at the top of each vertical spindle of this machine, to wind the yarn on the bobbin. In order to handle the yarn satisfactorily, it is necessary to rotate the flyers and bobbins at different speeds. By reason of independent drives to the flyer and bobbin through skew bevel gears, the desired rotation and relative speeds are easily obtained. Each fly frame carries many flyers and bobbins, and the horizontal driving shafts are very long. An offset drive of some kind is necessary in order that the vertical spindles and the horizontal shafts may pass without interference; hence skew bevel gears are usually employed. The teeth of these gears have always been cast, resulting not only in objectionable noise but also in a considerable assembly expense. Recently cut face gears were given a thorough try-out in place of the cast gears, and the results have been most gratifying. The noise has been greatly reduced and expense cut down appreciably.

At the right in Fig. 13 is shown a pair of cast skew bevel gears commonly employed on fly frames. At the left is seen the cut face gear and pinion which are so satisfactorily performing the service. In this case the face gear teeth have been spirally cut by a helical cutter corresponding in all essentials to the pinion here shown. The cutter was offset when producing the gear teeth, being located in the position occupied in the illustration by the pinion. The pinion is a helical gear.

There are other interesting developments which, for one reason or another, cannot be presented here. The examples shown, however, indicate that the gear business is far from the saturation point. It is apparent, too, that our endeavors should not be confined to standardization work of the various kinds and to human relationship problems, necessary and great as all this work is. We should fare forth as explorers and as promoters of the gear industry, remembering that perseverance wins.

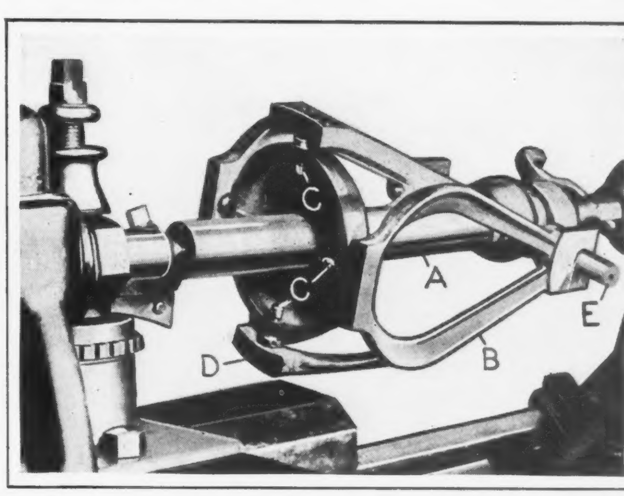
* * *

SPECIAL ARBOR FOR MACHINING BASE OF TRANSIT STANDARD

By ROBERT MAWSON

The lathe arbor shown in the accompanying illustration at A is one of the many special devices employed at the plant of W. and L. E. Gurley, Troy, N. Y., manufacturers of engineering and surveying instruments. The work B, mounted on the arbor, is a one-piece transit standard designed to give the required rigidity and strength with the least possible weight. This part is made from a casting of tough bronze. The frame is of angle cross-section, and has diagonal cross-bracing.

The work is located on the arbor by means of the pin E which passes through reamed holes in the sides of the standard head. The four jack or poppet screws C are tightened in order to hold the casting rigidly against the cutting strains during the facing operation. The four base surfaces, one of which is shown at D, are faced while the work is held in position on the rotating arbor. The method employed for locating and holding the work insures that the faced surfaces will be at right angles to the reamed holes through which pin E passes.



Lathe Set-up used in facing Base of Transit Standard

COOPERATION BETWEEN SHOP AND ENGINEERING DEPARTMENTS

By D. D. WELLS

The article "Cooperation of Engineer and Designer" which appeared in June MACHINERY on page 771 brought a great many things to the writer's mind regarding cooperation between the shop and engineering departments. Without cooperation it is impossible to have efficiency, and efficiency means maximum production with minimum labor.

Cooperation in Development of Design

Most ideas and inventions have their beginning in the engineering department. Before an idea can be developed into a drawing or lay-out, it must be conceived in the mind. After the idea has become a clear mental picture, it should be presented to an engineering committee whose business it is to study the fundamental principles and to decide if it is practical. This committee should consist of the chief engineer, designer, shop superintendent, factory manager, and production manager. The designer should make sketches of the machine or object as the different parts are discussed in the meeting. Immediately after the meeting, the designer should develop a lay-out from the sketches while the ideas are still clear in his mind. The designer and engineer should cooperate in working out all the complicated parts, and endeavor to make them as simple as possible. After the lay-out is complete, it is again presented to the engineering committee. The complicated parts should be thoroughly discussed in an effort to eliminate any defects in design or construction. If there are no changes to be made in the design, the lay-out is next given to the draftsmen who make up detailed drawings of each part.

After the details are completed and checked up, they are sent to the shop where the first experimental machine is to be built. The superintendent, foreman, and all the workmen who are to be engaged in the building of the machine should cooperate with the engineering department in determining upon limits, fits, clearances, and all other pertinent factors so that the drawings may be kept up to date. Often this is not done, and many changes go through the shop without the knowledge of the engineering department. This shows a lack of cooperation and causes much confusion and trouble when new prints are sent to the shop. There is even more confusion when repair parts are to be sent out for a machine that has already been installed at some distant plant. For this reason, an accurate record should be kept of all changes on drawings, which can be referred to at any time. There are many good systems for keeping a record of this kind, but any record is worthless unless it is kept up to date.

The cost of experimental work on machinery and inventions nearly always runs up into large sums. This work generally includes designing, pattern work, machining, and assembling. Great care should be taken to avoid errors in all departments engaged in the production of an experimental machine. Errors in this kind of work are sometimes difficult to locate and are always a source of expense. Even a simple error in designing or machining a small part may prevent the completed machine from functioning properly. Of course it is often necessary or desirable to redesign certain parts after the machine has been tried out. Minor defects in design or construction are almost sure to appear when the machine is tested. The purpose for which the machine is designed and the conditions under which it is to operate must be considered in testing the first machine that is to be taken as a model for building new machines. While the experimental machine is being tested, the engineering committee should carefully watch its operation, and at the completion of the test, they should thoroughly inspect the machine to see that each part has functioned properly.

Cooperation in Planning Production

After the trial machine has passed inspection and has fulfilled requirements, it should be routed for production by the planning department. This department makes a separate and thorough study of each part drawing for the purpose of working out the most efficient routing sheets. It also cooperates with the tool committee in planning the routing sheets, so that arrangements can be made for performing the various operations in their proper order. This is one of the most important factors in obtaining efficiency in the machine shop, and much care should be taken in planning the order or sequence of operations. This is not always done, and the operations are sometimes changed many times, necessitating changes in tools, which usually results in much confusion in the various departments. When a change of this kind is made it always results in considerable expense and a loss of time.

After the routing sheets have been finished, they should be turned over to the tool committee for a tool "line-up." The tool committee should consist of the chief tool designer, superintendent, tool supervisor, tool foreman, and foreman of the department in which the tool is to be used. If the shop does not have an efficiency department, the tool committee should work out the routing sheets as agreed upon at the meeting. The tools for each separate operation are thoroughly discussed as to design and cost. During this discussion the chief tool designer should make rough sketches of the ideas submitted. These sketches are turned over to the designers for lay-outs. The design of the tool, jig, or fixture should be thoroughly worked out by the designer with the cooperation of the chief tool designer.

After the lay-outs are finished, they are again brought up for discussion before the tool committee. If the lay-outs are approved by the members of the tool committee, they are signed by them in a space provided for their signatures. After the lay-outs are approved and signed they are turned over to the draftsmen for detailing. The casting details should be made on separate sheets; this makes it convenient for the patternmaker, and the details of the steel parts are sent only to the departments where they are required. The lathe and planer details are also put on separate sheets, which aids the tool-room foreman in distributing the work among the men.

Methods Employed in the Tool-room

In making the tools, any error found in the drawings or the design by the toolmaker should be reported to the tool designer at once. This is an example of real cooperation. Small changes and minor disagreements can be settled with little difficulty at this time. After the tool, jig, or fixture is finished, it should be thoroughly inspected and checked by the tool-room inspection department to see if it agrees with the drawing. If the tool passes inspection, it is then tried out in the shop by machining a few pieces of work. The work is then inspected and checked with the drawings. Before the tool is returned to the tool-room crib, it is stamped with the tool number, the part number, and the name of the operation it performs. The tools should be thoroughly covered with a heavy oil or grease before they are stored away in their allotted place in the tool-crib, in order to prevent them from rusting.

The tool committee should have a meeting at a certain hour each day for the purpose of discussing the different problems that arise in the shop. This committee should include the foremen of all the machine departments. After the meeting, a bulletin should be posted giving the subject that was discussed at the meeting and the decision arrived at. Problems that can be discussed at such meetings are numerous, and with a little cooperation between the different departments most of them can be solved with comparatively little difficulty.

* * *

The Forest Products Laboratory of the United States Forest Service, Madison, Wis., has published a complete table of working stresses for structural timbers. This table is issued in conjunction with Technical Note No. 201, which may be obtained from the Forest Products Laboratory.

Manufacturing Auger and Machine Bits

By CHARLES O. HERB

WHEN the average man buys an auger bit from a hardware dealer and pays forty or fifty cents for it, he does not realize that about forty-five distinct operations are performed in forging, machining, and polishing the tool, and that the capital invested by the manufacturer in forging dies alone runs into very large figures. The maintenance costs of the forging and polishing departments are also high, and it is only by producing bits in large quantities that they can be marketed at the prices quoted. The operations involved in producing these apparently simple tools will be described in the following article, the practice referred to being that of Greenlee Bros. & Co., Rockford, Ill. This concern manufactures from 130,000 to 150,000 small woodworking tools, such as auger and machine bits, ship augers, hollow and carpenters' chisels, gouges and draw knives, per month.

Except for the quality of the steel and the type of shank, there is no difference between an auger bit and a machine bit. The auger bit is a hand tool, and hence is provided with a square-section shank to fit the socket of a carpenter's brace, whereas a machine bit is made with either a round or a tapered shank to suit the machine for which it is intended. Auger bits are made from open-hearth carbon steel, and machine bits from crucible steel. However, the various steps of forging, machining, and polishing are identical, except for the operation on the shank. More than sixty distinct types of boring tools are made by this company, and as many as forty-seven sizes are made of some types.

Four of the most common styles of machine bits are shown diagrammatically in Fig. 4. A double-twist bit is shown at *A*, a solid-center bit at *B*, a ship auger at *C*, and a countersink bit at *D*. Different types of bit heads are also supplied on both auger and machine bits, as, for instance, "double spur," "extension lip," and "acme," and the screw points may have single or double threads of a variety of pitches. Machine bits are made up to 6 inches in diameter and 6 feet in length.

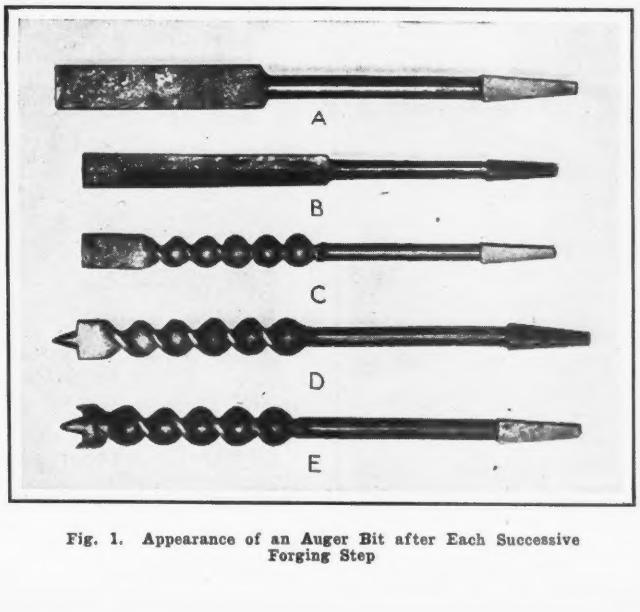


Fig. 1. Appearance of an Auger Bit after Each Successive Forging Step

Selecting the Stock and Forging the Shank

All bits with the ship-auger and solid-center type of twist are made from round stock, while double-twist bits are made from square and flat stock. The different sizes and kinds of stock are kept separate on shelves in a large stockroom, and each bar is painted a certain color on the ends according to its analysis, so that it is an easy matter to specify the proper heat-treatment for any lot of bars started through the shop. In selecting the size of stock for an order, the points to be considered are whether the shank or the twist is to be larger in diameter, and whether the twist is to be especially heavy or the spurs and screw point extra large. The stock is cut off to length in a machine shear equipped with a stop gage, and then placed in sheet-metal trays or tote boxes, which provide a convenient means of keeping all the bits of one order together while going through the different operations. Incidentally, the trays also permit of readily tracing imperfect work back to the man responsible for it.

The first operation on the stock for an auger bit consists of forging the square shank and the round section between the shank and the part to be twisted, as shown at *A* in Fig. 1, assuming that the stock is flat. Prior to all forging steps the stock is heated in a furnace, the temperature of which is held approximately at 1500 de-

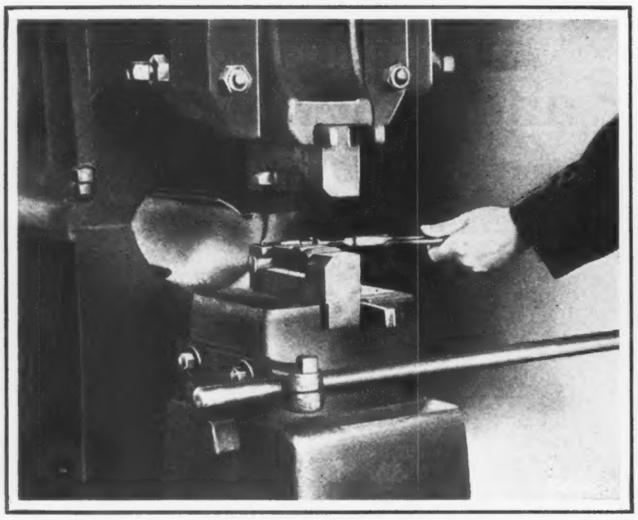


Fig. 2. Hammering the Round Portion and Square Shank of an Auger Bit

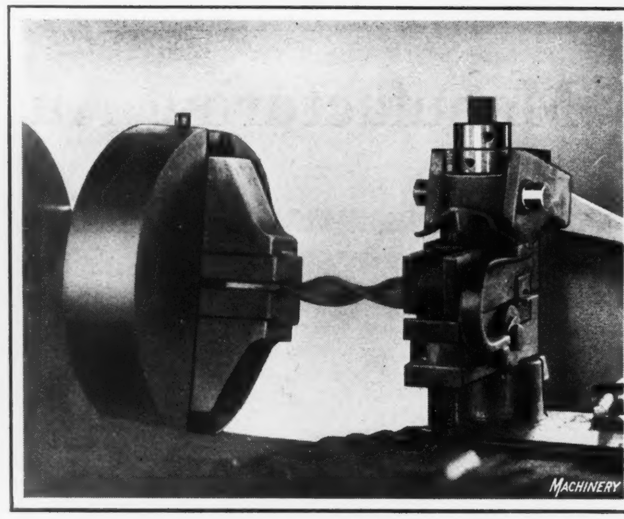


Fig. 3. Twisting a Bit made from Flat Stock, in a Specially Equipped Lathe

grees F., an oil furnace being provided for each power hammer. Fig. 2 shows the die in the hammer employed for the first operation. The die-blocks have several round grooves of different depths in which the round portion of the shank is formed by revolving the stock successively in the different grooves between the hammer blows. The square shank is formed by holding the end on the top surface of the bottom die-block at the rear, and giving the bit quarter turns, as necessary, until the shank has been hammered to size. The dies are tapered to suit the desired taper of the shank. Compressed air is constantly directed on the bottom die-block to blow away scale falling from the stock during the hammering. If the shank is to be round, it is formed by turning the end in semi-circular grooves in a die between hammer blows. All hammering operations are performed under Bradley hammers, this shop being equipped with a battery of twenty-three of these machines.

Twisting and Crimping the Bit

A preliminary operation is necessary before the actual twisting of a bit to bring the length to be twisted to an elongated diamond cross-section with a flat top and bottom, as shown at *B*, Fig. 1. The end that is later formed into the head is also flattened in this step. This operation is performed under a hammer which is of the same size as that illustrated in Fig. 2, and equipped with dies having but one impression. Between the blows directed on the flat sides, blows are also directed on the two edges of the sides to make this section the desired width. In these two forging operations, the hammer is operated with rapid heavy strokes at the beginning, and light finishing taps at the end.

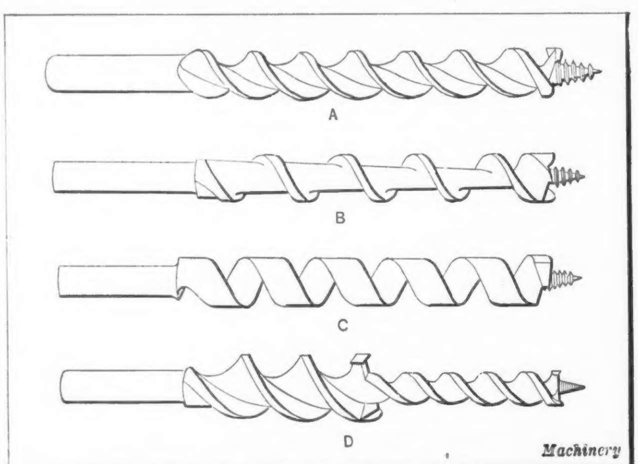


Fig. 4. Several Types of Machine Bits for boring Wood

From the standpoint of the forging shop, there are two general classes of bits—those made from flat stock, hammered as shown at *B*, Fig. 1, and twisted, and those forged directly in a hammer die from round stock. The twisting of the bits in the first class is performed on a lathe, as shown in Fig. 3, equipped with a two-jaw chuck in which the head end of the bit is gripped, and a special carriage in which the shank is clamped. The chuck revolves slowly and twists the bit, the shank being held stationary in the carriage, and the carriage being drawn toward the chuck as the bit length decreases. The bit twists more easily at the chuck end than at the carriage end, and so the operator assists the twisting near the carriage end with a special pair of tongs, and thus

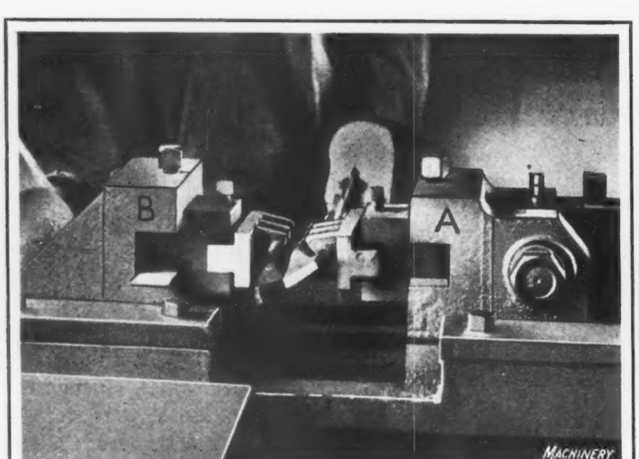


Fig. 5. Crimping Operation for making the Twist Uniform and Central

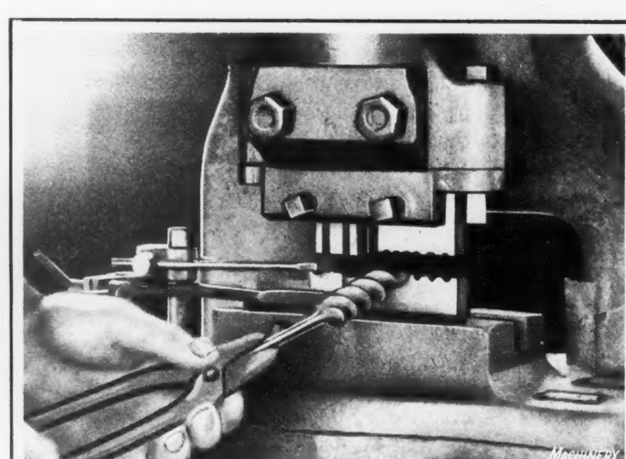


Fig. 6. Rounding the Point after the Excess Stock has been cut off

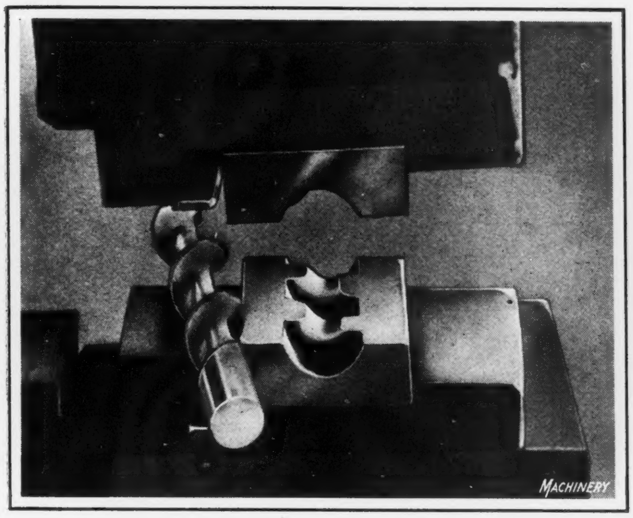


Fig. 7. Dies employed in forging the Twist of a Bit from Round Stock

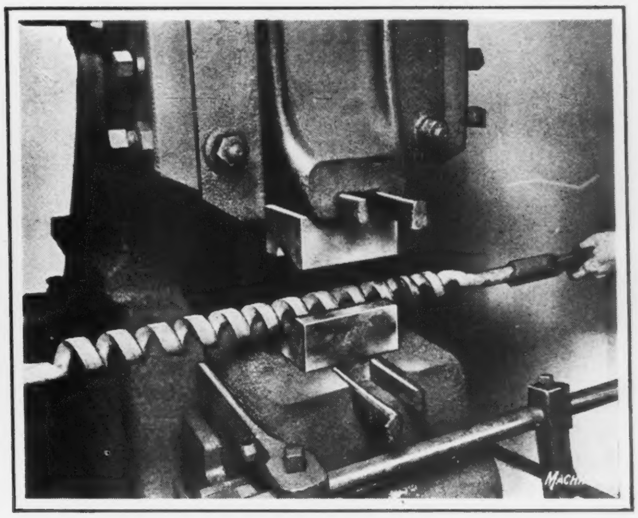


Fig. 8. Ship Auger being screwed through Bottom Die in Final Hammering

produces an approximately uniform twist. Close control of the revolving chuck is obtained through a quick-acting lever. The success of this operation depends, to a large extent, upon heating the bit to the proper temperature beforehand and heating it uniformly. When the heating has been satisfactory, similar points on each twist will be of a uniform thickness and the twist will be central.

A uniform and a central twist are insured by again heating the bit and "crimping" it, as shown in Fig. 5. The machine used for this operation is equipped with two dies having three projecting teeth, shaped to suit the twisted part of the bit. One die is held in the stationary member *A*, while the other is attached to ram *B*, which is reciprocated rapidly on a short stroke to strike light, quick blows on the bit as the operator screws it through the teeth of the die in member *A*. The teeth of one die are inclined opposite to the teeth of the other.

Forging Bits from Round Stock

When a bit is made from round stock, the first operation consists of forging the twist in hammer dies after the stock has been heated, unless the bit is to have a square shank, in which case the shank may be forged first. A pair of dies used in forming the twist on a solid-center bit is shown in Fig. 7, the cavities in the upper die being exactly opposite to those in the lower. It will be seen that there are two inclined teeth having a semicircular shallow recess which forms the solid center, and the twist is produced because of the deeper recesses between the teeth.

The twist is formed by first "breaking down" the work to the rough form, and then screwing the bit back and forth through the die, as illustrated in Fig. 8, until a straight and uniform twist is obtained. The rate of hammer blows is considerably increased for the finishing. After the twist has been formed, the end on which the screw point and cutting edges are to be formed is flattened. The bit shown in Fig. 8 is a ship auger. Considerable skill is required for the successful operation of most power hammers, and this is especially true in forging twist bits directly in hammer dies. It takes from two to three years for a man to become really skilled in this work.

Pointing, Heading, and Straightening

The next operation consists of shearing off the corners of the flat head to produce a triangular point, and then hammering this point to a round taper, as shown at *D*, Fig. 1. This is accomplished by hammering the point in the successive grooves of the dies shown in Fig. 6, and constantly turning it between the blows. The bit is also heated for this operation. The next step consists of hot-forging the head to form the spurs, as shown at *E*, Fig. 1. This is performed in a special upsetting machine of the horizontal type in which the bit is gripped along the twisted portion between two jaws, as shown in Fig. 9. The head is formed in one stroke by the die seen just ahead of the point, the point entering a hole in the die. The design of the die, of course, varies with the different types of heads desired, and the holding jaws must suit the diameter of the twist. Only the head end of the bit is heated preparatory to this step. The heads of very large bits are formed under a drop-hammer, with the bit held vertically.

The final operation in the forging shop consists of straightening the bit after it has once more been heated. Large bits are straightened by striking with a hand ham-

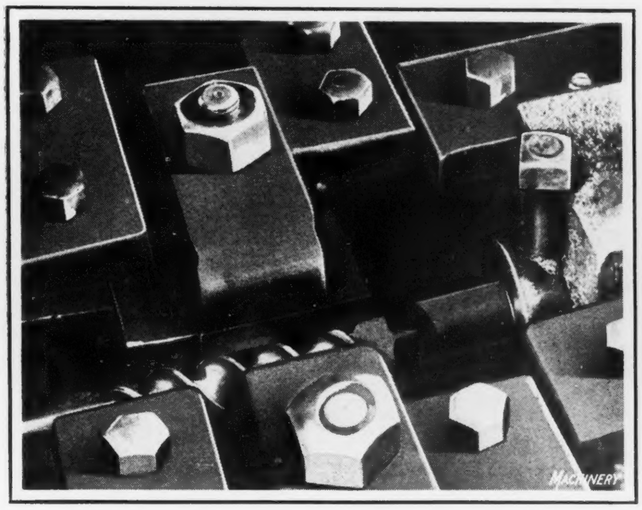


Fig. 9. Upsetting the Head to form the Spurs

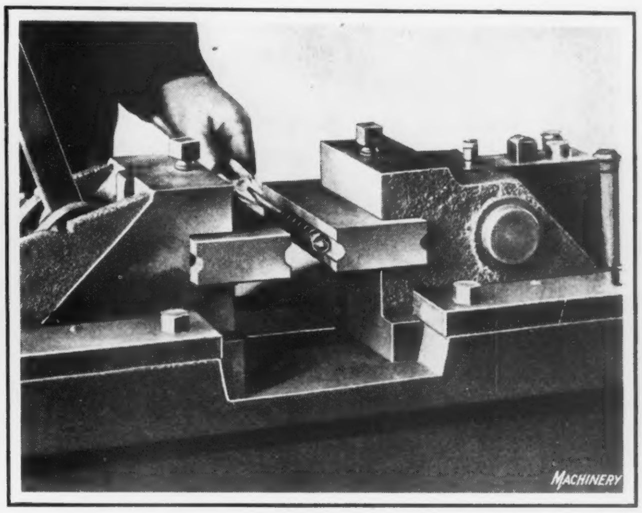


Fig. 10. Straightening the Twisted Portion

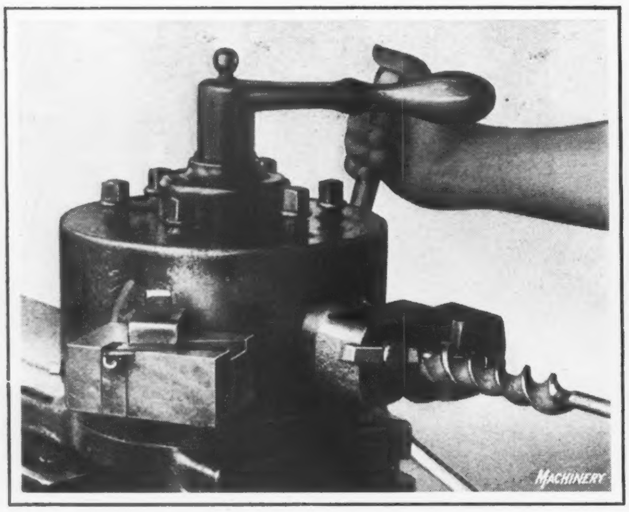


Fig. 11. Tools employed to turn the Tapered Point and the Head to Size

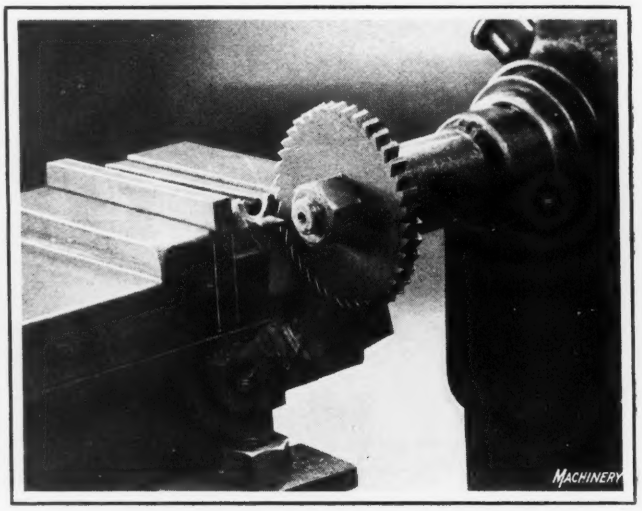


Fig. 12. Machining a Bit under the Radial Cutting Edges with a Milling Cutter

mer, as they are rotated on the point to determine the high spots, while the smaller sizes are straightened in the machine illustrated in Fig. 10. This machine is of the same type as the crimping machine shown in Fig. 5, but it is equipped with dies that have a simple half-round groove. The bit is revolved by hand between the rapid blows of the reciprocating die, thus eliminating crookedness. The large amount of capital invested in dies for the forging shop will be apparent when it is remembered that in each of the operations mentioned there must be a different set of dies for practically every type and size of bit manufactured.

Preliminary Machining Operations

After auger and machine bits have been forged, there are still many operations required, such as machining, filing, and polishing. These are mainly performed on special machines or by hand, as the peculiar shape of the twist usually obviates the use of standard machine tools and has obstructed the development of automatic machinery. From the forging shop the bits are taken to the heat-treating department for annealing all parts to be machined, auger bits being annealed only on the head, and machine bits at both ends, but neither at the middle. The portions to be machined are heated and then annealed by inserting in ground mica or lime and left to cool slowly. After annealing, the bits are dipped in sulphuric acid to remove scale, and then immersed in water to clean off the acid.

The first machining operation consists of taper-turning the point, and the second of "sizing" the head, or turning it to approximately the finished diameter. Both operations are now performed in rebuilt lathes, but the tools used are the same as those shown on the turret lathe in Fig. 11, in which the operation was formerly accomplished. The bit is held by the shank in a revolving headstock chuck for the first operation, and the cutter shown at the left, which is mounted in the tailstock spindle, is advanced on the point. Through a special arrangement the chuck is disengaged from the drive at the end of the operation, thus eliminating the necessity of shifting a countershaft belt for removing and replacing the work. The dimensions of the point are the same for each bit of one size, but vary for different sizes. For the sizing operation, the work is held in the tailstock spindle and advanced automatically into the box-tool shown at the right in Fig. 11, which is held in the headstock spindle. There is a spring center in the box-tool which receives the bit point and insures that the head will be machined concentric with the point by the two cutters.

In the case of machine bits, the shank is next turned in an engine lathe, small sized bits being supported by gripping the twist in the jaws of the headstock chuck, while large bits are held between centers. The name of the company and the size of the bit is then stamped on the shank, and this part of the bit is not machined further. The bit is next sent to a cylindrical grinding machine, illustrated in Fig. 13, in which the edge of the twist is ground to provide clearance when boring a hole. The bit is revolved between centers and fed back and forth across the grinding wheel. The work-table is adjustable relative to the wheel to obtain the desired angle of taper, which varies with the diameter and length of the twist. Some machine bits have a flat

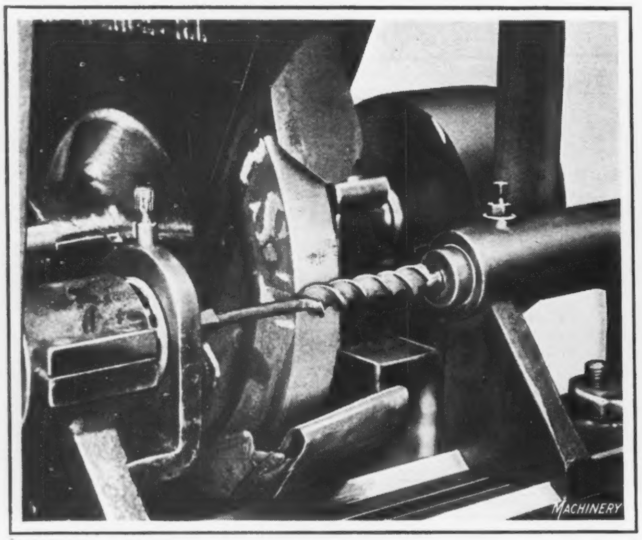


Fig. 13. Grinding the Edge of the Twist

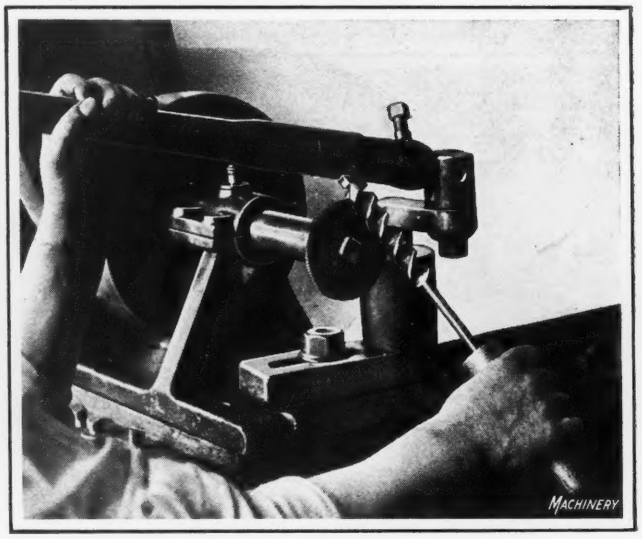


Fig. 14. Removing Excess Stock from the Throat

milled on the shank prior to this grinding.

"Fitting" and Filing the Head and Throat

Seven operations are necessary for removing the excess stock from the head of a double-twist bit, and practically the same number is required for other styles. These steps consist of milling or coarse filing operations, and bring the bit into condition fit for hand filing. One of the important factors governing the cutting qualities of a bit is the angle of slope given to the radial cutting edges at the head end. This angle must be a certain amount more than the angle at which the radial edges cut into the wood, owing to the lead of the screw point, but if the angle is too great, excessive power is required to drive the bit. The bit is cut to the desired "clearance" angle by a milling cutter having slightly angular teeth, as illustrated in Fig. 12.

Fig. 15. Preliminary Filing or Sharpening of the Radial Cutting Edges

The "throat" of a bit is that part of the spiral in back of the cutting edges up which the chips pass as they start to follow the twist. One of the steps employed in removing the stock from the throat is illustrated in Fig. 14. The bit is held and rotated by the right hand of the operator, with the point inserted in a small socket in the lever, the operator using his left hand to manipulate the lever and guide the bit throat on the revolving cutter. It will be noticed that the cutter has file-like teeth. Although the throat need not be fitted to a positive size or angle, it must be shaped to obviate any tendency of the chips to choke. After the preliminary fitting has been completed, the head and throat are filed by hand to finish-fit the top, shape the tapering spurs, and under-cut the screw point. One of these filing steps is illustrated in Fig. 15.

Cutting the Screw Point, Hardening, and Tempering

One of the most interesting operations in the entire process of manufacture is that of producing the thread on the screw point. This is accomplished, as illustrated in Fig. 16, by pressing the point against the high-speed disk *A*, which has a series of circular concentric grooves (not spiral) cut on its face, and feeding the bit back and forth across the disk face by revolving spool *B* of the fixture in which the bit is held. This spool is attached to screw *E*.

The bit must be fed longitudinally by the operator to roll the thread around the point at the desired lead; otherwise, circular grooves would simply be formed. The pitch and lead of the thread depend upon the pitch of the concentric rings on the disk, and so different cutters must be supplied for different sized bits and the threads of screw *E* must correspond in pitch to the grooves of disk *A*. Different cutters are also necessary for double and single threads. It will be obvious that the success of this operation depends largely upon the dexterity of the operator. Disk *A* is driven on the various machines at speeds ranging from 10,000 to 12,000 revolutions per minute. The point of the bit is supported by the upright rod *C*, which is adjustable for height. Burrs resulting from this operation are next removed by means of a hollow cutter, which is revolved in a simple head.

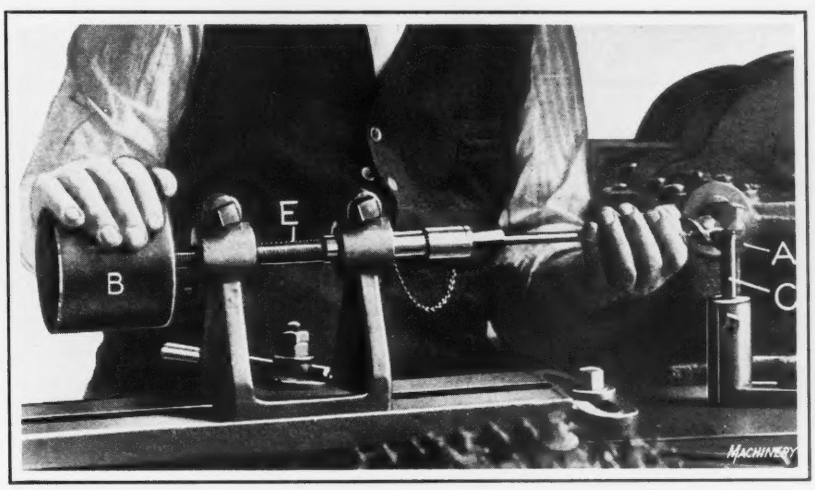


Fig. 16. Rolling the Thread on the Screw Point

After several rough-grinding operations have been performed on the head, the bit is again sent to the heat-treating department to be hardened and tempered. On some bits only the head is hardened by heating in a lead bath and quenching in oil, while others are hardened the entire length of the twist. After cleaning off the oil in water, a number of the bits are placed in a basket and again heated by immersing the basket in a vat of oil held at the desired temperature. After tempering, the bits are quenched in hot water to remove the oil. Large-sized bits are tempered one at a time.

Polishing Operations

Rubber bond abrasive wheels are used in the first of the polishing steps which are performed on the bits as they come from the heat-treating department, after hardening and tempering. The operation consists of taking light cuts in the hollow of the twist and throat, the bit being guided across the rotating wheel by hand, as illustrated in Fig. 17. The point is screwed into a wooden handle to facilitate turning the bit. Some of the grinding stands in this department are equipped with a member in which the bit can be held and rotated over the wheel. Wheels of different widths are necessary for the various sizes of bits, and for solid-center bits the wheel must be squared at the periphery instead of rounded as illustrated.

Leather wheels coated with abrasive from 60 grain to flour are used in the remaining polishing operations, four operations being performed on each surface with the exception of the shank of auger bits, which is left dull. The four polishing steps are called "rough," "oil," "smooth," and "finish"; the only difference between them is the grain of the abrasive, and the use of a slight amount of oil in the "oil" polishing. The size of the abrasive

Fig. 17. First Polishing Step on the Hollow of the Throat and Twist

Fig. 18. One of the Several Polishing Steps on the Edge of the Twist

grain naturally is smaller with the succeeding operations. The leather wheels for finishing the hollow of the throat and twist are of the same shape at the periphery as the rubber bond wheel shown in Fig. 17. The final polishing of the throat is effected by means of a piece of round leather, which is stretched taut in such a way that the bit can be rolled along it while exerting a pressure against it. One of the polishing steps on the edge of the twist is illustrated in Fig. 18. The round section between the twist and the shank is polished in a similar manner.

Because of the large amount of handling that the bits receive in polishing, the costs of this department are very high, being probably 35 to 40 per cent of the total cost of manufacture, but this amount of polishing is necessary to produce the high degree of finish that the trade demands. Large bits are frequently painted black in the hollow of the twist, thus eliminating part of the polishing of this surface. Full polishing of the hollows in large bits results in almost prohibitive costs.

Final Sharpening and Testing

Final sharpening of the bit is done by hand-filing after the "rough" and "oil" polishing and prior to the "finish" polishing. This step is similar to the rough filing or sharpening which was done before hardening and tempering. Polishing of the screw point is accomplished by placing emery powder on it and screwing it into a wooden plank of hard maple. This also serves as a trial to determine whether the point will pull itself readily into the wood. Before packing the bit for shipment, it is revolved in a high-speed head to determine whether it runs true, and if there is any crookedness, the high spots are straightened out by tapping lightly with a lead hammer. The bits are then individually inspected for shape, temper, and finish, after which they are wrapped in protective paper, packed in boxes, and placed in stock.

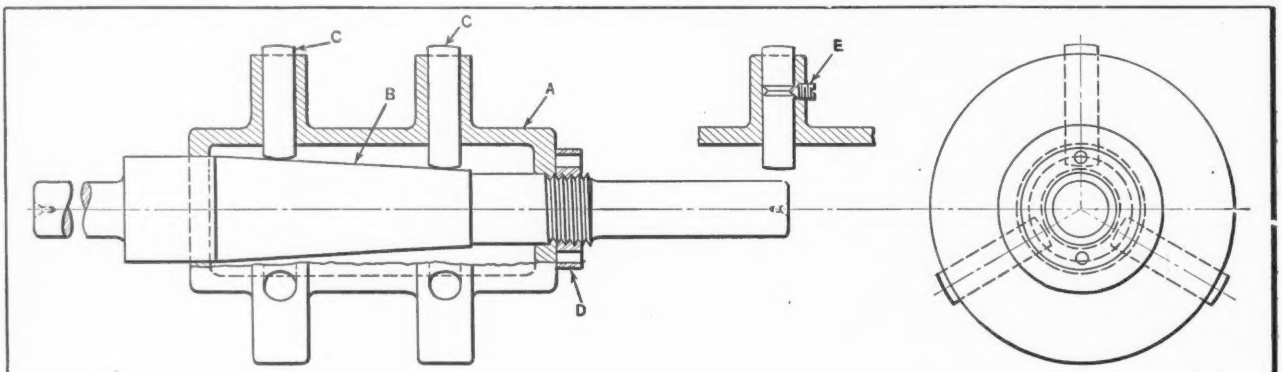
MANDREL FOR BALANCING OPERATIONS

By JOHN E. UNGER

Expansion mandrels for balancing parts that are to rotate at high speeds should be light in weight and yet strong enough to support the work without being deflected when rotated at extremely high speeds. It is also necessary that they retain their dynamic and static balance when set to fit any size of bore within their range of adjustment. The skeleton expansion mandrel illustrated has been found to fulfill these requirements. This type of arbor is also suited for grinding and light turning operations.

The mandrel consists essentially of the body *A*, the taper arbor *B*, the grip-pins or jaws *C*, and the round nut *D*. Nut *D* serves to actuate the taper arbor *B*, which, in turn, forces the pins *C* outward. The range of the mandrel can be increased by simply employing longer or shorter pins *C*. No babbitt hammers or hydraulic presses are required for inserting this mandrel in the work, as it is simply dropped into place and expanded by tightening nut *D* while the work is located in a vertical position upon a surface plate. Washers of different thicknesses are provided as spacers between the body *A* and the nut *D*.

The body *A* should be made of machine steel for the smaller sizes, and of cast iron for the larger sizes. Steel bushings should be used to support the taper arbor when a cast-iron body is used. The pins *C* are made from drill rod or tool steel, and are a close fit in their respective sockets so that their outer ends can be ground after the mandrel has been completely assembled. If necessary, a groove can be machined in the pins *C* and pointed set-screws employed, as shown at *E*, to keep the pins in contact with the taper arbor while their outer ends are being ground. The convex grinding of the ends of the grip-pins is done in a special chuck after the pins have been hardened. The size of the mandrel is governed by the size of the work.



Expansion Mandrel provided with Six Grip-pins, for Use in balancing Parts or for holding Work during Light Turning or Grinding Operations

CLEARANCE FOR BOLT HEADS AND NUTS

By JOHN S. WATTS

Bolt holes should be so located on machine parts that a standard wrench can be employed for removing or tightening the nut on the bolt. This important point is often overlooked by the designer or draftsman. Of course in some instances it is necessary to locate a bolt hole where there is just sufficient room to insert the bolt and turn down the nut. However, when possible, bolt holes should be so located that a standard wrench can be used.

The accompanying table has been prepared for the purpose of assisting the draftsman and designer in locating bolt holes in accordance with the requirements mentioned in the preceding paragraph. The dimension *A* as given in the table is the minimum distance from the wall of the casting to the center of the bolt hole that will permit the nut to be turned. This dimension should never be made less than the value given in the table, and should always be made greater unless other conditions make it impossible to do so. The most desirable values for this dimension are given in column *M*, and nothing is gained by exceeding these values. The sizes given in this column should be adopted as standard.

The value of *A* for both hexagonal and square nuts is given in the table, but the use of hexagonal nuts is recommended in preference to square nuts, except where there is ample space and the joint is required to be broken frequently. In the latter case a square nut may be preferable, as it provides a larger holding surface for the wrench. Generally a square-headed bolt with a hexagonal nut is the best combination, especially when the joint is designed with a step (as indicated by dimension *B*) to prevent the bolt from turning.

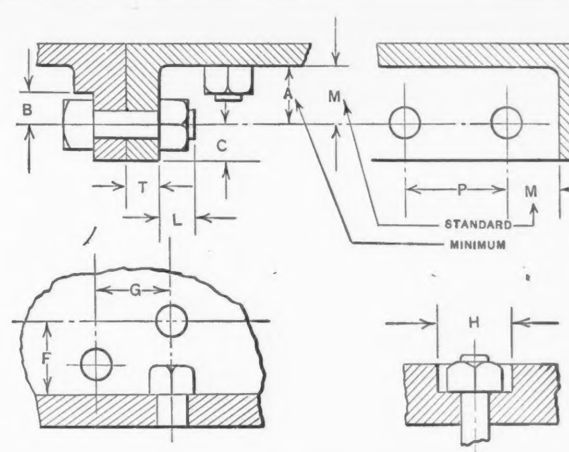
Dimension *B* is the distance from the center of the bolt hole to the stop-shoulder just referred to, and if made according to the table will prevent either square- or hexagonal-head bolts from turning while the nut is being tightened or loosened. It is surprising how seldom this effective little kink is employed when we consider the time wasted in assembly work where it is necessary to employ two wrenches in order to tighten the nut on the bolt.

Dimension *C* is the distance from the center of the bolt hole to the outer edge of the flange and should not be made smaller than the value given. No advantage will be gained, however, in making this dimension greater than the given values. Dimension *L*, if added to the total thickness of the flanges *T*, will give the required length of the bolt. The bolt selected should be of a length equal to dimension *L* or the next longer size. The maximum and minimum dimensions *T* give the thickness of the flanges for a given bolt diameter. Of course the calculated strength of the bolts must be sufficient to carry the load that is to be imposed on them. With so many variables to be considered, it is generally necessary to determine the size of bolt and number of bolts required, thickness of flanges, etc., by "cut and try" methods.

In most cases, it is best first to determine on the thickness *T* which should be about, but not more than, 1.5 times the thickness of the adjacent walls of the casting. Having obtained the dimension *T*, the number of bolts required is next calculated. The thickness *T* of the flange determines the diameter of the bolt. The number of bolts required depends on the total load that they are to carry.

With the diameter of the bolts and the number to be used thus determined, the pitch or the center-to-center distance between the bolts can be calculated. If the pitch thus obtained is within the limits indicated in the table, the joint will have sufficient strength; otherwise, larger or smaller bolts must be used, and the flange thickness altered to suit requirements. By making the flange as thick as conditions permit, it will be possible to use bolts of comparatively large diameters, and as the cost of a set of bolts that will

TABLE OF CLEARANCES FOR NUTS AND BOLT HEADS



Diam. of Bolt	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2
A* Hex. Nut	5/16	3/8	7/16	1/2	9/16	5/8	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2
A* Sq. Nut	3/8	7/16	1/2	9/16	5/8	11/16	13/16	15/16	1 1/16	1 1/4	1 3/8	1 1/2	1 5/8	1 3/4
B	5/16	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8	15/16	1	1 1/8	1 1/4	1 3/8
C	3/8	7/16	1/2	9/16	5/8	11/16	3/4	7/8	1 1/8	1 1/8	1 3/8	1 1/2	1 5/8	1 3/4
L	3/8	1/2	1/2	5/8	5/8	3/4	3/4	1	1 1/8	1 1/4	1 1/4	1 1/2	1 5/8	1 3/4
T Min.	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2
T Max.	5/16	3/8	7/16	9/16	5/8	3/4	15/16	1 1/16	1 1/8	1 1/4	1 1/2	1 5/8	1 3/4	1 7/8
P Min.	7/8	1 1/8	1 5/16	1 9/16	1 3/4	2	2 1/4	2 5/8	3	3 1/2	4	4 3/8	4 7/8	5 1/4
P Max.	1 1/2	1 7/8	2 1/4	2 5/8	3	3 3/8	3 3/4	4 1/2	5 1/4	6	6 3/4	7 1/2	8 1/4	9
F	3/4	15/16	1	1 3/16	1 1/4	1 7/16	1 1/2	1 7/8	2 3/16	2 1/2	2 5/8	3	3 1/4	3 1/2
G	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 5/8	1 7/8	2 1/8	2 3/8	2 5/8	2 7/8	3 1/8	3 3/8
H	7/8	15/16	1 1/16	1 3/16	1 5/16	1 1/2	1 5/8	1 7/8	2 1/8	2 3/8	2 5/8	2 7/8	3 1/4	3 1/2
M	5/8	11/16	15/16	1	1	1 1/8	1 1/4	1 3/8	1 5/8	1 7/8	2	2 1/4	2 3/8	2 3/4

Machinery

* "A" is minimum; use dimension "M" as standard whenever possible.

give a certain holding strength decreases with the increase in the size of bolt used, this practice will prove economical.

The maximum and minimum pitch for each size of bolt (the minimum pitch is the smallest pitch that will permit the use of a standard wrench on the nuts) is given in column *P*. The maximum pitch is the pitch at which the flanges begin to show a tendency to spring open between the bolt spaces. The maximum pitch should never be used in cases where the parts are subjected to more than a few pounds pressure.

A pitch about midway between the two extremes is perhaps the most efficient. The dimension *F* should not be made less than the values given, when two bolts are in line; otherwise it will be impossible to screw the nuts on the bolts. Dimension *F* must be accepted as the minimum value unless the bolts are placed out of alignment a distance not less than that indicated by dimension *G*. The correct diameter of a counterbore for a recessed nut is given as dimension *H*. This diameter is the minimum diameter which will permit a box type wrench to be placed over the nut. Dimension *M* is the distance from the center of a bolt hole to a rib or wall which will permit a wrench to be used, and as was mentioned previously, this dimension is the most desirable one for the space between the wall and the center of the bolt.

* * *

INCREASING THE SCOPE OF TABLES OF SQUARES

By A. H. CANDEE

In October MACHINERY, on page 108, there appeared an article entitled "Increasing the Scope of Tables of Squares," in which a method was given for obtaining the squares of numbers ending in 5, and having one more figure than the numbers in the table referred to. There is another considerably shorter method for such calculations, based on a very old rule for squaring numbers ending in 5. In the shorter method, we disregard the final figure 5, multiply the remaining part of the number by the next higher integer, and affix 25 to the product. Thus, the square of 65 is obtained by multiplying 6 by $(6 + 1) = 6 \times 7 = 42$, and writing 4225 as the required square. The basis for this rule is shown by the following algebraic outline, in which the number to be squared is given as $(10n + 5)$.

Now

$$(10n + 5)^2 = 100n^2 + 100n + 5^2$$

or

$$(10n + 5)^2 = 100n\,(n + 1) + 25$$

For large numbers it is more convenient to use the first form for the square. The arithmetical work for squaring 3195 is then as follows:

Complete Form		Abbreviated Form
$100 \times 319^2 =$	10,176,100	$319^2 =$ 101761
$100 \times 319 =$	31,900	319
$5^2 =$	25	
	10,208,025	10208025

This short-cut in calculation is very easy to remember, and can be used frequently by anyone dealing with figures. [Similar solutions have also been submitted by W. Hansen, Detroit, Mich., and Reuel L. Smith, Cincinnati, Ohio.—EDITOR].

By ROBERT HOFSTETTER

The writer read with interest the article "Increasing the Scope of Tables of Squares," which appeared on page 108 of October MACHINERY. Another method of using the tables of squares that is based on the formula

$$(a + b)^2 = a^2 + a2b + b^2$$

has been found very convenient by the writer. Attention is called to the method of writing the second term of the squared value, namely, $a2b$. The usual expression would be $2ab$. Employing the preceding equation for the solution of the three problems given in October MACHINERY, we have:

$$(319.5)^2 = (319)^2 + 319 \times 2 \times 0.5 + 0.5^2$$
$$(12.125)^2 = (12.12)^2 + 12.12 \times 2 \times 0.5 + 0.5^2$$
$$(1.1875)^2 = (1.187)^2 + 1.187 \times 2 \times 0.5 + 0.5^2$$

Obviously it is only necessary to look up one value in the tables and add two figures directly to the tabular value in order to obtain the answer to any one of these examples. If the number to be squared was 3195, the equation would be

$$(3195)^2 = (3190 + 5)^2 = 3190^2 + 3190 \times 2 \times 5 + 5^2$$

which again requires the taking of only one value from the tables. That the same method can be applied for five place figures is shown by the following example in which 28916 is to be squared.

$$28916^2 = (28900)^2 + (28900 \times 2 \times 16) + (16)^2$$

and in order to use simple addition, the expression $(28900 \times 2 \times 16)$ is split up into two values, which are written $28900 \times 30 + 28900 \times 2$. The solution of this problem may then be written in the form:

$28900^2 =$	835210000
$28900 \times 30 =$	867000
$28900 \times 2 =$	57800
$16^2 =$	256
Total	836135056

That the same tables can be used to obtain the square root to five places may be shown by taking the answer of the last example and dividing it into periods of two figures each so that we have 8.36.13.50.56, which indicates that there will be five places in the answer. Now in the table of squares we find that the square root of 835210000 = 28900. Now subtracting 835210000 from 836135056 we obtain the difference 925056. From the table of squares it is found that the difference between 289^2 and 290^2 is 579. Dividing 925056 by 579 (using the slide-rule and disregarding the decimal point) we find that the first two figures of the answer are 16 which added to 28900 gives the correct answer 28916.

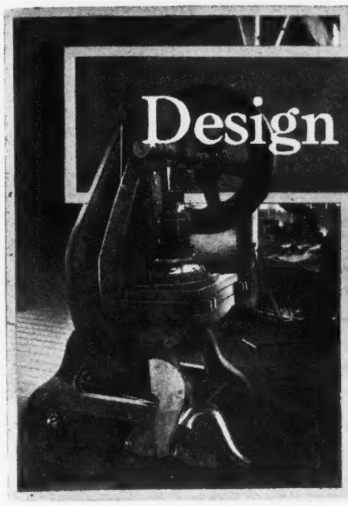
* * *

WORK OF AMERICAN ENGINEERING STANDARDS COMMITTEE

The Year Book of the American Engineering Standards Committee for 1923, has just been issued, and copies may be obtained by addressing the committee at its headquarters, 29 W. 39th St., New York City. The Year Book gives a great deal of information relating to the standardization work under consideration. It mentions that at present 205 national bodies—technical, industrial, and governmental—are cooperating in engineering standardization work through officially accredited representatives. The number of individuals serving on the appointed committees at the end of 1922 was 917. Of the standardization subjects under consideration 23 related to mechanical engineering; 15 to electrical engineering; 21 to civil engineering and building; 3 to the automotive industry; 12 to transportation; 19 to ferrous and non-ferrous metals; 12 to chemical subjects; 1 to shipbuilding; 2 to the textile industry; 4 to the mining industry; and 9 were of a miscellaneous nature. Among the more important mechanical subjects under consideration may be mentioned bolt, nut, and rivet proportions; screw threads; pipe threads; ball bearings; plain limit gages; gears; pipe flanges and fittings; shafting; welded and seamless steel pipe; welded wrought-iron pipe; small tools; and machine tool elements.

* * *

Fire losses are in effect a tax on every business and on every man, woman, and child in the United States. This is one case where the tax-payers entirely by their own efforts can reduce the rate.—*Herbert Hoover.*



Design of Inclinable Power Presses

Designing the Brake Mechanism for a Power Press, Including Estimating the Weight of the Reciprocating Parts, Determination of the Width and Diameter of the Brake Drum, and Calculation ot Other Brake Parts

By P. A. FRIEDELL

THE function of the brake on a power press is to stop the crankshaft at the top center of its stroke, as well as to prevent the reciprocating parts from dropping when the clutch is disengaged. If properly designed and adjusted, and if the clutch disengaging mechanism is properly located, the brake should stop and hold the crankshaft at the top dead center of its stroke. Under no circumstances should the brake be permitted to become so loose on the brake-drum as to allow the crankpin to travel 10 degrees past its upper center. Therefore, the brake may be calculated to be fully effective in supporting the weight of the reciprocating parts, including the crank, connection and its cap and screw, ball cap, slide, and punch, when the crank-pin is 10 degrees from its vertical center.

It will be assumed that the clutch is constructed in such a manner as to control these reciprocating parts when it is engaged. The brake may be of a design similar to that illustrated in Fig. 1. It is important that the brake be self-compensating or adjusting to cover the allowable wear on the lining. In the type illustrated, a hinge and spring is utilized for this purpose, an arrangement which has been found to be very effective.

Approximating the Weight of the Reciprocating Parts

In designing a brake for a power press, a rough approximation of the weight of the reciprocating parts is first required. The weight of the punch may be assumed from the size of die it is possible to install, which, in turn, is governed by the area of the bed and the die space. As an illustration, it will be assumed that the dimensions of the bolster plate, from front to back and from right to left are 18 by 26 inches. Allowing 3 inches for a flange and 1 inch for the cutting edge, a punch 10 by 18 inches could be installed, the maximum thickness of which would be one-half the die-space. Next assuming a die space of 8 inches, the punch thickness would be 4 inches, another assumption being that the slide does not enter the gibs. This punch would weigh approximately $10 \times 18 \times 4 \times 0.26 = 187$ pounds.

If the press were designed to allow the slide face to enter the gibs, the maximum size of the punch would equal twice the distance from the center line of the slide to the housing. Assuming that the dimensions of the bolster plate on a press of this design are 27 11/16 by 20 inches, and the die space, 8 inches, the maximum-sized punch would measure approximately 20 by 12 by 4 inches, and its weight would be about $20 \times 12 \times 4 \times 0.26 = 249.6$ or 250 pounds. Assuming the weight of the reciprocating parts exclusive of the punch to be approximately 530 pounds, the brake should be designed to control a weight of $530 + 250 = 780$ pounds when the crank is 10 degrees past dead center, at the top of its stroke.

The twisting moment due to this weight is

$T = 0.1736Yt = 0.1736 \times 780 \times 1 = 135$ inch-pounds

in which

T = twisting moment due to weight of reciprocating parts, in inch-pounds;

Y = weight of reciprocating parts; and

t = throw of crankshaft = 1 inch.

Determining the Width and Minimum Diameter of Brake

For the purpose of maintaining uniformity in the design of a press, it is advisable to base brake calculations on the diameter of the crankshaft at the main bearings. The diameter of the brake does not lend itself readily to this system; however, the width may readily be calculated as follows: Assuming the diameter d of the crankshaft at the main bearings to be $4\frac{3}{8}$ inches, width W, Fig. 1, of the brake may equal $0.25d + 1$ inch to the nearest quarter inch, or $(0.25 \times 4.375) + 1 = 2.093$ or 2 inches.

It is not advisable to utilize the end of the crankshaft as a brake-drum, because in such a design practically all the heat generated by the brake is transmitted to the adjacent main bearing. The brake-drum and strap should be so designed as to radiate heat to the greatest extent, and therefore should have no unnecessary finished surfaces, but as great a radiating or exterior surface as possible. It is advisable to finish only the bore of the drum, the hub end which bears against the shoulder of the crankshaft, and the periphery.

The brake design illustrated in Fig. 1 provides a very light drum and requires a minimum amount of machining. It will be

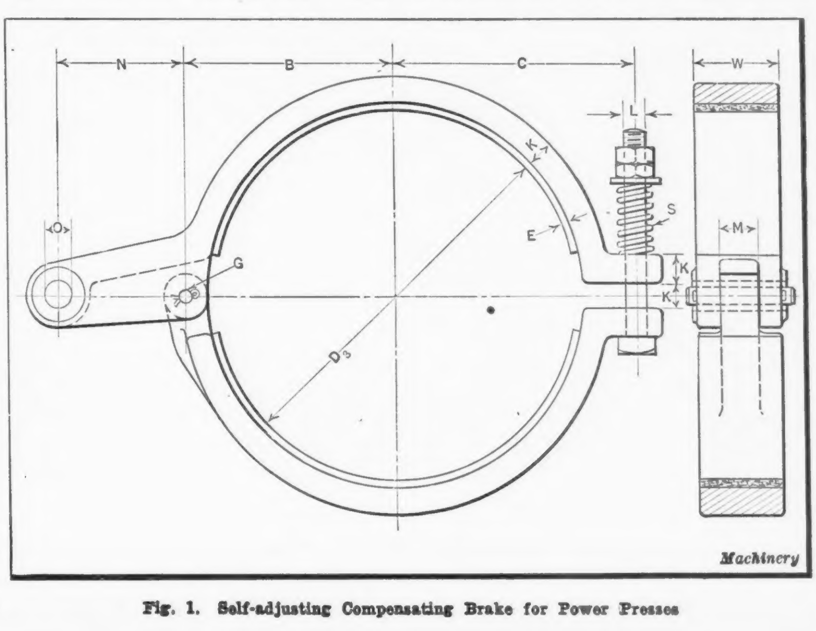


Fig. 1. Self-adjusting Compensating Brake for Power Presses

assumed that in designing the crankshaft, bore d_3 of the brake-drum, Fig. 2, is found to be 4 11/32 inches. If desired, this dimension may be made to some definite standard so as to make a set of drums increasing in diameter, say, in steps of 1 inch, interchangeable on crankshafts of various diameters. For instance, this dimension could be made 3 inches for crankshafts from 3¼ to 4¼ inches in diameter, and 4 inches for diameters ranging from 4¼ to 5¼ inches. This system works out well where a line of presses of various capacities are built. Under these conditions, width W, Fig. 1, would be based on the intermediate diameters or 3¾ and 4¾ inches, respectively.

The brake diameter may now be found by the following calculations (see Fig. 2):

$H = 0.2d_3 + 0.25$ inch $= (0.2 \times 4.34) + 0.25 = 1.118$ or 1⅛ inches

$d_3 + 2H = 4.34 + (2 \times 1.125) = 6.59$ or 6⅝ inches = diameter of hub

$U = 0.03d_3 + 0.25$ inch $= (0.03 \times 4.34) + 0.25 = 0.38$ or ⅜ inch.

A should not be less than ⅜ inch.

$W + 0.125 = 2⅛$ inches = width of brake-drum.

Therefore, the minimum diameter D_3 of brake $= 6.625 + (2 \times 0.375) + (2 \times 0.375) = 8.125$ or 8⅛ inches. The diameter of brake actually required because of the load may be calculated by the formula

$$D_3 = 0.4\sqrt{\frac{T}{2}}$$

Thus,

$$D_3 = 0.4\sqrt{\frac{135}{2}} = 3.29 \text{ or } 3\tfrac{1}{2} \text{ inches}$$

As this dimension is less than the minimum obtained in the foregoing, the diameter obtained in the first calculation for dimension D_3 should be used to the next higher half or even inch, or, in this case, 8½ inches.

Other Brake Dimensions

Referring again to Fig. 1, dimension D_3 is the same as in Fig. 2 or 8½ inches.

$E = 3/16$ inch = thickness of brake lining

$L = 0.1d_3 + 0.125$ inch (to nearest standard size) $= (0.1 \times 4.34) + 0.125 = 0.559$ or ½ inch

$G = 0.5L + 0.125$ inch $= (0.5 \times 0.5) + 0.125 = 0.375$ or ⅜ inch

$$C \text{ (trial value)} = \frac{D_3}{2} + W = \frac{8.5}{2} + 2 = 6\tfrac{1}{4} \text{ inches}$$

$$B = \frac{D_3}{2} + G + 0.375 \text{ inch} = \frac{8.5}{2} + 0.375 + 0.375 = 5 \text{ inches}$$

The formulas for block brakes given in connection with Fig. 1, page 522, of MACHINERY'S HANDBOOK, apply to the present brake, considering it as a double-block brake, which reduces the necessary spring pressure one-half. Therefore, if

F = spring pressure required, in pounds;
P = tangential force, in pounds, at rim of brake-drum; and
u = coefficient of friction between brake lining drum = 0.37 for asbestos.

Then,

$$P = \frac{2T}{D_3} = \frac{2 \times 135}{8.5} = 31.76 \text{ pounds}$$

$$F = \frac{\dfrac{PB}{C+B}\left(\dfrac{1}{u}\right)}{2} = \frac{\dfrac{31.76 \times 5}{6.25+5}\left(\dfrac{1}{0.37}\right)}{2} = 19.08, \text{ say } 20 \text{ pounds}$$

Spring S should roughly fit the bolt; therefore, for purposes of calculation, a trial value of ⅝ inch may be assumed for the mean diameter D of the spring. The wire should be of a diameter d that will have a capacity of about twice force F.

Then d may be determined by the formula

$$d = \sqrt[3]{\frac{2FD}{31{,}400}} = \sqrt[3]{\frac{2 \times 20 \times 0.625}{31{,}400}} = 0.0927 \text{ inch}$$

say Washburn & Moen No. 13 wire gage which is 0.0915 inch in diameter.

Then the inside diameter of the coil $= 0.625 - 0.0915$ or 0.5335 inch.

Recalculating the spring pressure,

$$Q = \frac{31{,}400 \times 0.0915^3}{0.625} = 38.5 \text{ pounds}$$

The deflection f per coil under full load is found as follows:

$$f = \frac{QD^3}{1{,}500{,}000d^4} = \frac{38.5 \times 0.625^3}{1{,}500{,}000 \times 0.0915^4} = 0.089 \text{ inch}$$

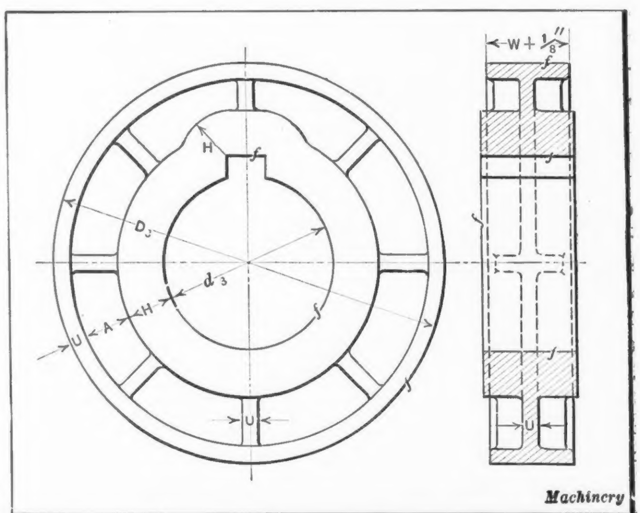


Fig. 2. Design of Drum intended for Installation with the Brake shown in Fig. 1

Free height per coil $= d + f = 0.091 + 0.089 = 0.18$ inch

$$\text{Number of coils per inch} = \frac{1}{0.18} = 5.5 \text{ or } 5\tfrac{1}{2}$$

The required total deflection equals the allowable wear on the brake lining multiplied by 6, or $6 \times 0.25 = 1.5$ inches, and the total number of coils in the spring equals the number of live coils required plus 2. Thus the total number of

$$\text{coils} = \frac{1.5}{0.089} + 2 = 18.8 \text{ or } 19 \text{ coils.}$$

$$\text{The free height of the spring} = \frac{17}{5.5} + (2 \times 0.0915) = 3.27 \text{ inches.}$$

The solid height of the spring $= 19 \times 0.0915 = 1.74$ inches.

Calculating the Thickness of the Brake Strap

Thickness K of the brake strap may be calculated from the formula

$$K = \sqrt{\frac{6QCB}{1000W(C+B)}}$$

in which

Q = spring pressure;
B = distance from fulcrum to center of brake;
C = distance from center of brake to point where spring pressure is applied; and
W = width of brake strap.

Then,

$$K = \sqrt{\frac{6 \times 38.5 \times 6.25 \times 5}{1000 \times 2\,(6.25+5)}} = 0.5535 \text{ or } 9/16 \text{ inch}$$

$$\text{Length of bolt} = 3K + 3L + \frac{\text{solid height of spring} + \text{free height}}{2} =$$

$$(3 \times 0.5625) + (3 \times 0.5) + \frac{1.74 + 3.27}{2} = 5.19 \text{ or } 5\tfrac{1}{4} \text{ inches}$$

$$C = \frac{D_s}{2} + K + L + 0.375 = \frac{8.5}{2} + 0.5625 + 0.5 + 0.375$$

$$= 5.687, \text{ say } 5\tfrac{3}{4} \text{ inches}$$

$$M = 0.45W = 0.45 \times 2 = 0.9 \text{ or } \tfrac{7}{8} \text{ inch}$$

N should preferably be made so that a larger brake can be used if required, as, for instance, where a longer-stroke crankshaft is installed in the press after it is built. In the present instance, N will be assumed as 3 inches.

$$O \text{ (minimum)} = \sqrt[3]{\frac{TW}{588\,(B + N)}} - 0.1875$$

$$= \sqrt[3]{\frac{135 \times 2}{588 \times 8}} - 0.1875 = 0.57 \text{ or } \tfrac{5}{8} \text{ inch}$$

The brake illustrated in Fig. 1 requires no machining when properly cast with oil sand cores. This is a decided advantage from the standpoint of cost, as well as from that of radiation. The hole for pin G may be cored 1/16 inch over-size, and the holes for screw of diameter O and the spring bolt should be cored ⅛ inch over-size for sizes up to 1 inch, 3/16 inch over-size for bolts from 1 to 1½ inches, and ¼ inch over-size for bolts from 1½ to 2 inches. It is only necessary to drill holes for receiving the copper rivets used for fastening the brake lining in place.

The brake lining should be made of a good quality of asbestos, not less than and preferably 3/16 inch thick. Leather and wood are not very satisfactory materials for this purpose, as they burn out readily.

The power consumed by the brake of a power press may be excessive when the reciprocating parts are heavy. Under such circumstances, the reciprocating parts should be counterweighted. Tests made on power presses have sometimes shown as much power consumed by the brake as is actually consumed in doing the work. If the number of revolutions per minute N of the crankshaft is taken as 120 and T represents the twisting moment, which was found to be 135 inch-pounds, the horsepower H consumed by the brake may be found by the following formula:

$$H = \frac{TN}{63{,}025} = \frac{135 \times 120}{63{,}025} = 0.257$$

* * *

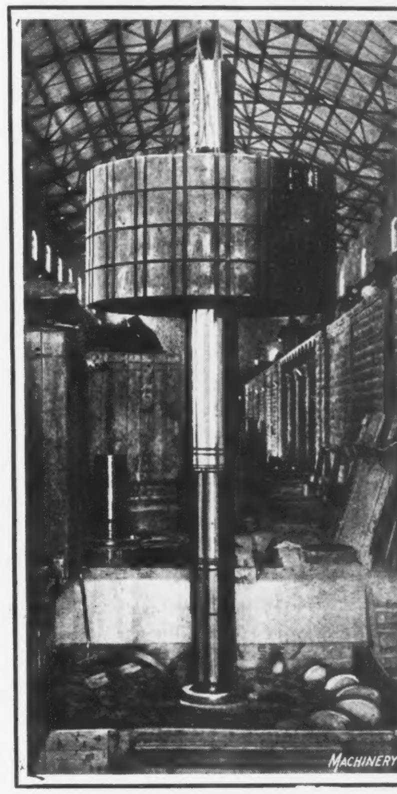
ASSEMBLING ROTOR SPIDERS ON SHAFT

When installing the equipment for the hydro-electric plant of the Andhra Valley Power Supply Co. near Bombay, India, C. V. Foulds, field engineer for the Pelton Water Wheel Co., San Francisco, Cal., developed a novel method of assembling the shaft, rotor, and water-wheel runner shown in the accompanying illustration. The completed plant at which the assembling was done comprises six 10,000 k.v.a. General Electric generators, each driven by a single overhung Pelton impulse turbine.

Each shaft assembly comprised four rotor spiders weighing 8 tons apiece, the water wheel runner, weighing 12 tons, and the shaft itself weighing 9 tons, making a total of 53 tons. The final assembly weighed 73 tons, but the twenty field poles for the rotor, weighing a ton apiece, were naturally not added until the rest of the assembly was completed. The bore of the runner and spider hubs was 0.003 inch smaller than the shaft diameter, which was 22 inches.

Largely on account of the lack of skilled labor, it was decided to heat the spiders and runner by steam and shrink them on, rather than employ the usual press-fitting methods. Accordingly a "steam box" large enough for one of the rotor spiders was constructed, and a spider lowered into it. Steam was then supplied by a 1-inch pipe from a donkey boiler outside the building. Four or five hours of steaming was required, which increased the diameter of the bore from 0.003 inch less than the shaft to 0.012 inch more. Further steaming made only a slight additional increase, the time allowed being apparently sufficient to bring the spider up to approximately the temperature of the steam.

The first spider to be applied was necessarily the one next to the outboard bearing, so that in standing the shaft on end for insertion, it was necessary to grip it by a friction clamp over the journal itself, as there was no collar to keep the clamp from slipping off. The clamp used was made of two 12- by 12-inch teak timbers, fitted to the curvature of the journal and held together by two pieces of 12-inch I-beam 3 feet long with three 1½-inch bolts at each end. Forged links of 1½-inch steel were looped over the double hook of the crane.



Turbine Shaft, with Rotor Spiders assembled, Ready to be lowered into Steam Box containing Water Wheel Runner

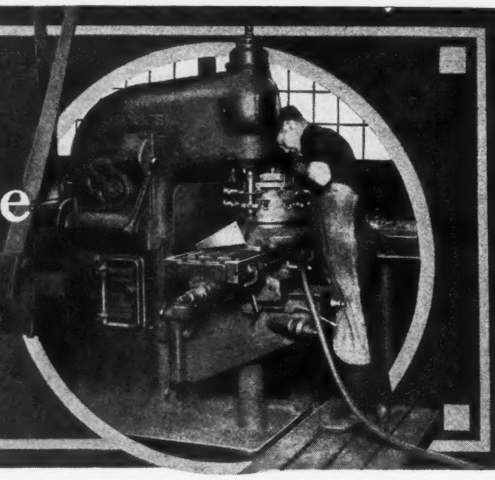
At the conclusion of the required steaming period, the steam was shut off and the box opened. The bore was then wiped out and its diameter checked before inserting the shaft, which went in easily. For the first spider on each shaft a stop was attached to prevent the shaft from entering too far. The other spiders stopped against the ones already in place. After the first spider had shrunk in place, the lifting clamp was removed and the hoisting done with slings through the spider.

To guard against looseness in the main key and to insure alignment of the pole slots of the four spiders, a long key with one end tapered was made to fit the slots exactly, and as each pair of spiders came together it was inserted and left in place until the last spider to be added had cooled and gripped the shaft. The time of cooling was prolonged as much as possible, twelve hours being usually allowed for it, although the hub began to grip the shaft after one hour.

Aside from the cleaning and preparation of the hubs and shaft that would be required whatever the method of assembly employed, the actual work for each hub required one man for eight hours to tend the boiler and the crane, and four men for two hours to make the insertion and later to withdraw the assembly and place another spider in the box. The same procedure was followed for the turbine runner, except that a slightly larger steam box was used and seven hours of steaming was required instead of five. In one case five hubs were set on a shaft in as many days.

When the shaft assembly, weighing 53 tons, had been completed, and was hanging from the crane with the turbine runner down, an overhanging step was provided on one of the pit walls on which was rested the outer hub of the runner, permitting the entire assembly to be lowered to a horizontal position without placing any weight on the buckets. The assembly was then picked up again and set in the bearings.

Manufacturing Automobile Valve Tappet Parts



Intensive Methods Employed at the Plant of the Hudson Motor Car Co. in Attaining High Production Rates with Standard Machine Tools

GREATLY increased efficiency has been attained during the last few years in the shops of the Hudson Motor Car Co., Detroit, Mich., by the adoption of new or improved methods of machining and handling the work. For instance, in March, 1920, with 8216 employes, 6126 automobiles were turned out, and although this was considered a fair production, the revised methods resulted in the production of 7147 cars during May, 1922, slightly more than two years later, with only 4365 employes. This represented an average increased efficiency per workman of approximately 120 per cent. One of the departments pointed to with particular pride, because of its high rates of production, is that in which the valve tappet parts are manufactured. The machines and equipment by means of which these parts are produced will be described in this article.

An assembled valve tappet is illustrated in Fig. 1, together with the more important details. These details consist of the tappet guide *A*, tappet *B*, roller pin *C*, and roller *D*. Dimensioned drawings of these four parts are presented in Figs. 2 and 3. The tappet parts for both the Hudson "Super-Six" and the Essex automobiles have been standardized to such an extent that they are turned out on similar machines with but little difference in their set-up. The operations on the tappet guide, which is machined practically all over, will be followed first.

Equipment for Machining the Tappet Guide

The first operation on the tappet guide is performed on a No. 24 New Britain automatic equipped with the tooling illustrated diagrammatically in Fig. 6. This machine has four working positions and one chucking position, the latter being at the top of the work-holding turret. The reference letters in Fig. 6 indicate the same surfaces as the corresponding letters in Fig. 2. The work is held in a chuck having two jaws shaped to suit periphery *A* of the tappet guide flange. For the purpose of approximately centering the work in the chuck prior to clamping it, part *Q*, which is held in the position of the tool-head opposite the idle position of the turret, is pulled back into contact with the shank of the tappet guide. Obviously, part *Q* centers the work because of the tapered recess in its front end, and it is withdrawn before indexing the turret.

When the tappet guide has been indexed to the first working position, the turret is advanced to bring the work into contact with the revolving counterbore shown in the holder at *W*. The counterbore is employed to break away the scale at the shank edge of the cored hole extending through the guide, and it is ground away at the front end to an angle of 45 degrees. The counterboring facilitates drilling the hole in the succeeding operation. In the second working position the tappet guide is fed to the tools shown at *X* which consist of a 31/32-inch drill for drilling the hole in the guide for about one-half its length; two turning tools for rough-turning surface *B* (slots *K* and *L* have not yet been produced); and another lathe tool for facing the shank end of the guide to length.

In the third working station the tooling shown at *Y* is used for finish-drilling the hole in the center of the guide and for turning surfaces *C* and *D* and facing surface *E*. The fourth and final operation on this machine consists of reaming the hole to 0.996 inch in diameter with the set-up illustrated at *Z*. On this machine the tools revolve constantly, but the feeding of the work in and out ceases at each indexing, so as to permit the operator to replace the finished piece, when it reaches the idle position, with a rough casting. The machine is started after the work has been placed in the chuck, by simply operating a lever. With one operator tending two of these machines, an average production of 240 guides per hour is obtained on the two machines.

In the next operation on the tappet guide, which is performed on a Cleveland automatic, surface *A* of the head is finish-turned, surfaces *F* and *G* are faced, the shoulder between these surfaces is turned, and the hole is beveled at the top end. The operator loads the standard rotary tilting magazine with work, as illustrated in Fig. 4, and as the magazine work-holders advance intermittently to the front of the machine, each successive piece of work is grasped by the fingers of a sliding arbor, which are pushed into the hole, the arbor being mounted on the turret diametrically

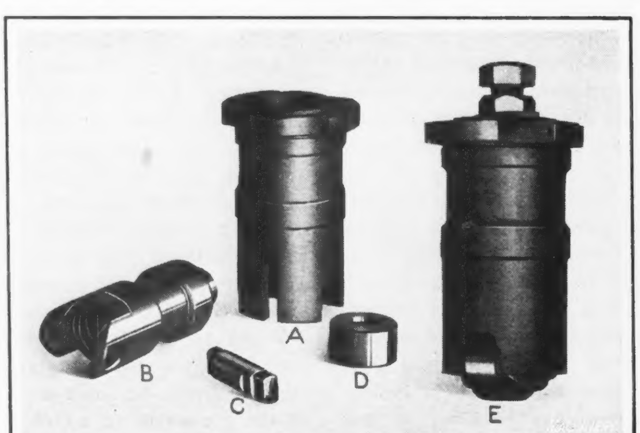


Fig. 1. Valve Tappet and Disassembled Parts used in the Hudson "Super-Six" and Essex Automobile Engines

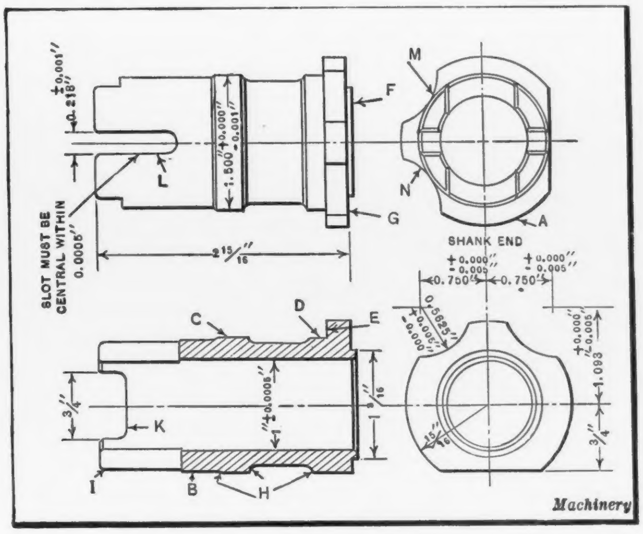


Fig. 2. Valve Tappet Guide Casting

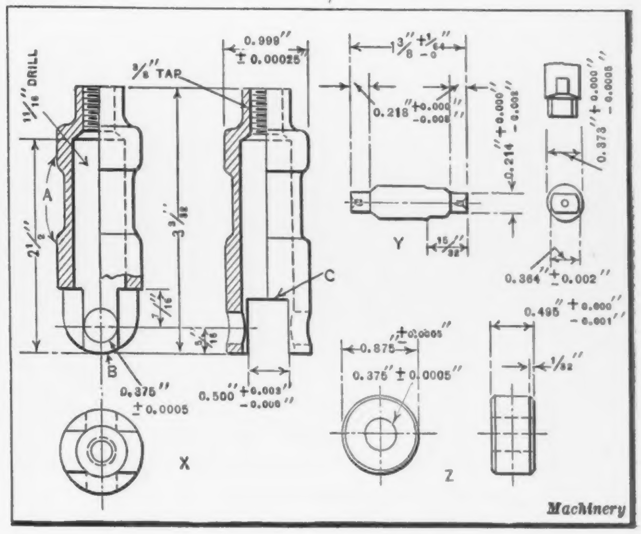


Fig. 3. Tappet, Roller Pin, and Roller

opposite the tool-holder. These expanding fingers withdraw the piece from the magazine as the arbor slides back. The carrier on which the work is now held, is next revolved into line with the chuck of the machine and slides the work into the chuck, where it is held as the carrier is withdrawn. The turret again revolves to bring the tool-head in line with the work, after which the tool-head advances and performs the various operations on the work already mentioned.

When all the cuts have been taken and the tool-head is withdrawn, a cam operates the chuck and ejects the work. While this operation is in process the operator finish-reams the hole of the guide by slipping it over a reamer mounted in a head at the front of the machine, as shown. In this operation a production of 240 pieces per hour is averaged. For an operation on iron castings, this one is unusually clean, as an exhaust system sucks away all fine dust from directly beneath the cutting tools into a container.

Lathe and Grinding Operations

Either a Sundstrand or a Porter-Cable lathe is next employed for cutting chamfers *H* and *I*, finish-turning surfaces *C* and *D*, and finish-facing surface *E* true with the hole and surfaces *C* and *D*. A recess is also cut in surface *D* close to face *E* to serve as grinding clearance in the next operation. The tooling employed for this work is illustrated in Fig. 5. The work is held on a pneumatic expansion arbor, which provides for quick loading and unloading. One operator tends two of these machines, and obtains an average production of 240 pieces per hour with the two machines.

The fourth operation on the guide consists of grinding surfaces *C* and *D* to 1½ inches in diameter, within a tolerance of 0.001 inch, on a Landis machine. A standard set-up is employed for holding the part between centers during this operation, and a Norton crystolon No. 36-L wheel is employed. The average production is 130 pieces per hour.

Milling Operations

The next operation consists of milling the large cam-roller clearance slot *K* and the roller-pin slot *L* on a No. 21B Milwaukee milling machine set up as shown in the heading illustration. It will be seen that two rows of parts are milled at one time, while held in a constantly rotating fixture, by employing two cutters on the vertical milling spindle. The parts are clamped in V-blocks in the fixture. Four parts are held by each clamp, equalizing members insuring that the same pressure is exerted on each part.

Slot *K* is produced with the tappet guide in the lower part of the fixture, and as this slot is finished, the part is removed and placed in the top part of the fixture for cutting slot *L*. Slot *L* must be cut directly at right angles to slot *K*, and this is insured by having an accurate block register in slot *K* as the work is placed in position for the second step of the operation. The work is inserted in the V-blocks from the inside. As this is an important operation, a compressed

Fig. 4. Automatic Screw Machine used for the Second Operation on the Tappet Guide

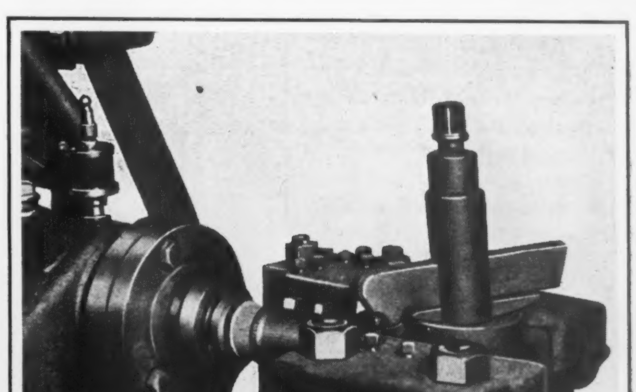


Fig. 5. Machine Set-up employed for the Third Operation on the Tappet Guide

air line is used to blow all chips from the V-blocks so as to insure accurate locating of the work. The production averages about 220 pieces per hour.

The final machining operation on the tappet guide is performed on either a Kokomo or an Aurora upright drilling machine, equipped as illustrated in Fig. 7. It consists of milling out the flanged head of the guide, as shown at *M* and *N*. The radius of these surfaces is held to a close tolerance, as well as their horizontal distance from the center of slot *L*. The latter dimension is assured by slipping the parts into a jig for this operation, a horizontal pin engaging slot *L*.

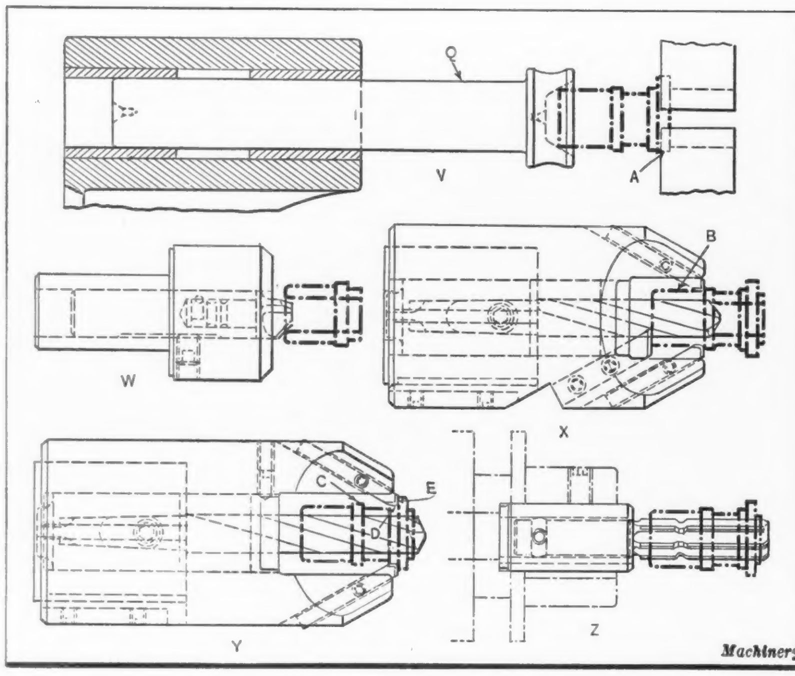


Fig. 6. Tooling Equipment for the First Operation on the Valve Tappet Guide

Two work-holding positions are provided in the jig so that two pieces of work are finished simultaneously as the head of the drilling machine is lowered to bring two piloted end-mills in contact with the work. The pilots enter bushings in the jig. As the drilling machine head is lifted when the operation has been completed, the operator depresses a foot-treadle to eject the work from the fixture. Compressed air is also blown across the face of this fixture after each operation, to cleanse it thoroughly from all chips and dirt. The production averages 330 pieces per hour. When the guide is removed from the jig, the hole is brushed out and thoroughly washed before the piece is assembled.

Operations on the Tappet

The tappet shown at *X*, Fig. 3, is formed, drilled, and tapped in a Cone automatic before coming to the tappet department. The first operation in this department consists of rough-grinding surfaces *A* in a Detroit centerless grinding machine, after which end *B* is rounded to a radius of 7/16 inch in a Milwaukee milling machine, set up as illustrated in Fig. 8. It will be seen that this machine is also provided with a fixture in which two rows of work are continuously carried past the cutters. The work is seated in V-grooves and held in place by pins, equalizing devices insuring an equal pressure on each part. Each clamp holds eight pieces and as there are seven clamps to the fixture, the fixture accommodates fifty-six pieces at one time. The production on this machine is approximately 600 pieces per hour.

After the rounding operation the parts are passed to another milling machine, set up almost identically with the first, but provided with staggered-tooth cutters for producing slot *C*, which receives the roller. The fixture holds the same number of pieces as that on the rounding machine, but the work is inserted from the inside of the fixture instead of the outside. The parts are properly located for slotting by V-grooves cut in the rings of the fixture that register with the rounded ends of the work. The production on this machine averages 440 pieces per hour.

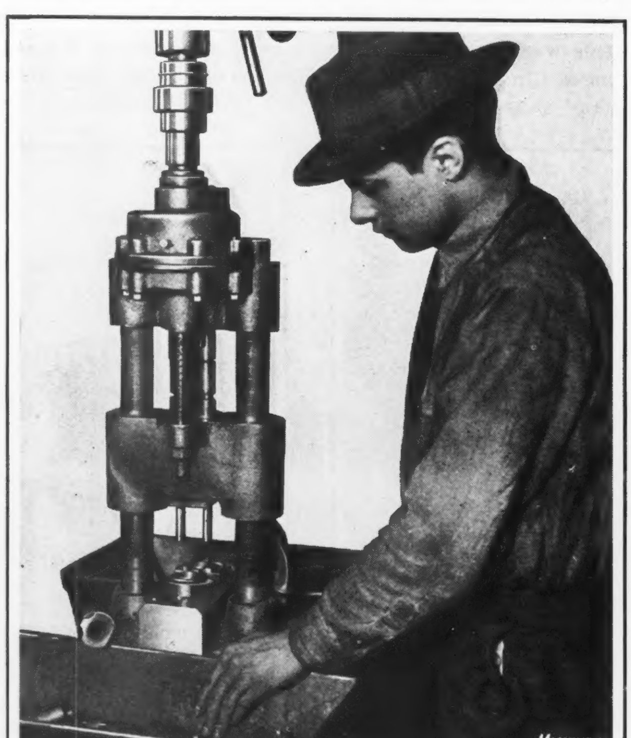


Fig. 7. Milling away the Flange of the Tappet Guide at Two Points

The next step consists of drilling the holes in end *B* to 23/64 inch, perpendicular to slot *C*, and central relative to the axis of the tappet. By using a simple jig, a production of 190 pieces per hour is obtained. These holes are then countersunk on the outside of the tappet, and surfaces *A* of the tappet are semi-finish-ground in a centerless grinding machine. The 23/64-inch holes are next reamed to 3/8 inch within a tolerance of 0.0005 inch in a single-spindle drilling machine at an average rate of 550 pieces per hour. The large hole is then counterbored at end *B* to remove all burrs produced in milling, this operation being performed on a bench head of simple design. Surfaces *A* are finally finish-ground on a centerless grinding machine to within a tolerance of one-fourth of a thousandth.

Grinding Operations on the Rollers

Cone automatics are also used in another department for producing the tappet rollers, which are heat-treated before being sent to the tappet department for finishing, this heat-treatment consisting of carburizing, cooling in pots, reheating in an electric furnace, and finally quenching in brine. The first operation after the pieces are received from the heat-treating department is performed on the Blanchard grinding machine illustrated in Fig. 14, and consists of grinding both sides. About 400 pieces are placed on the magnetic chuck for each operation, both the work and the chuck being thoroughly cleansed prior to the operation. From 0.003 to 0.005 inch of stock is removed from each side of the rollers, a standard stop being provided on the machine to insure that the desired amount of stock will be removed. The average production on this machine is 400 rollers about every 30 minutes.

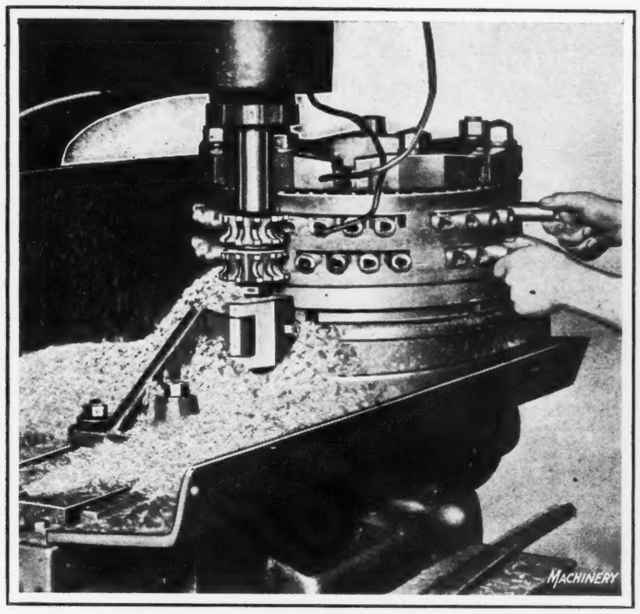


Fig. 8. Rounding One End of the Tappet preparatory to slotting it

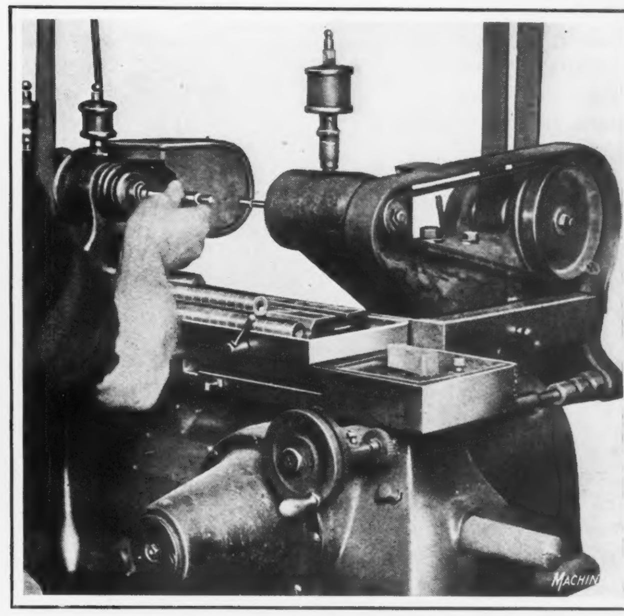


Fig. 9. Machining the Hole through the Center of the Roller

As the rollers are taken from the grinding machine they are dropped through a demagnetizer, and then from fifty to sixty are slipped on a long rod to facilitate running them through a centerless grinding machine, as illustrated in Fig. 15. This machine grinds the rollers to a diameter of 0.875 inch within a tolerance of 0.0005 inch. Each rod of rollers is run through the machine about four times, a rubber bond wheel being employed for the grinding. The operator of the Blanchard grinding machine also tends this machine, and the rate of production is the same.

The next operation on the rollers consists of grinding the hole. Rivett grinding machines are used for this operation, as illustrated in Fig. 9, the equipment being standard except for a suction blower mounted close to the work for drawing away the grinding dust. The exhaust line is arranged to follow the movements of the work-head. The work is held in a draw-back collet chuck and advanced to the grinding wheel. The operator applies a "Go" and "Not Go" plug gage to ascertain when the hole has been ground to the desired diameter. An average production of 75 rollers per hour is obtained. As the roller is taken from this machine the concentricity of its hole relative to the periphery is checked with an American amplifying gage which reads to 0.0001 inch.

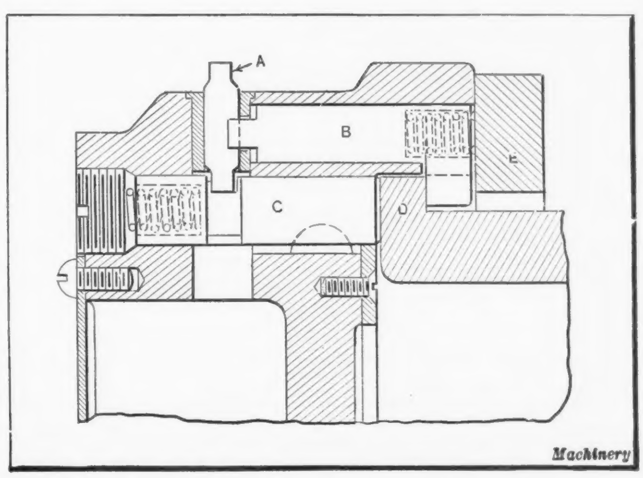


Fig. 10. Clamping Means employed in the Rotary Work-holding Fixture used on the Machine shown in Fig. 12

Operations on the Roller Pins

The roller pin shown at Y, Fig. 3, is turned and cut off to length in an automatic screw machine before being brought to the tappet department. Here the first operation consists of rough-grinding 0.010 to 0.012 inch of stock from the diameter in a centerless grinding machine equipped with a magazine which the operator keeps filled to obtain an average production of 3000 pieces per hour. The pin is ground at this point so it may be accurately seated in a vee for the next operation—straddle-milling the flats on each end.

This straddle-milling operation is performed on the milling machine illustrated in Fig. 11, which is equipped

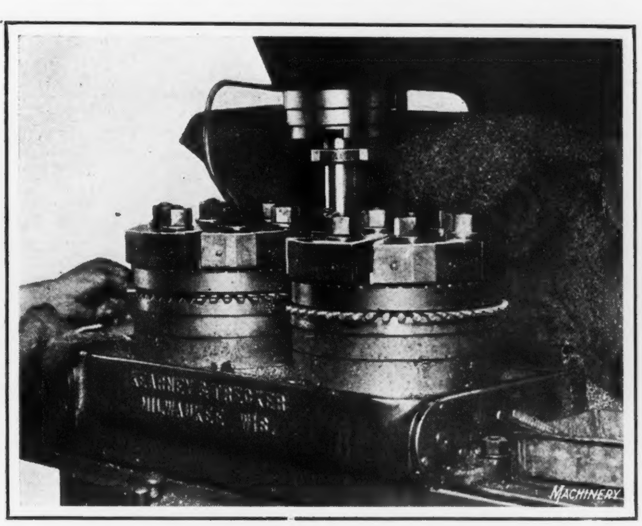


Fig. 11. Set-up of Milling Machine employed for slabbing the Ends of the Roller Pins

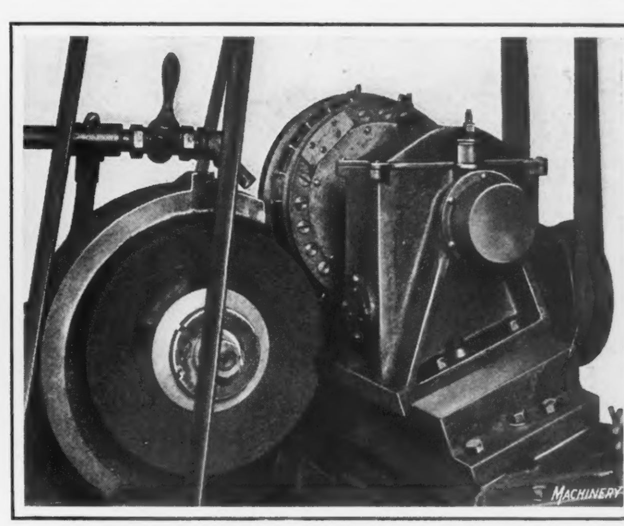


Fig. 12. Grinding Machine equipped with a Rotary Fixture that carries the Roller Pins between the Wheels

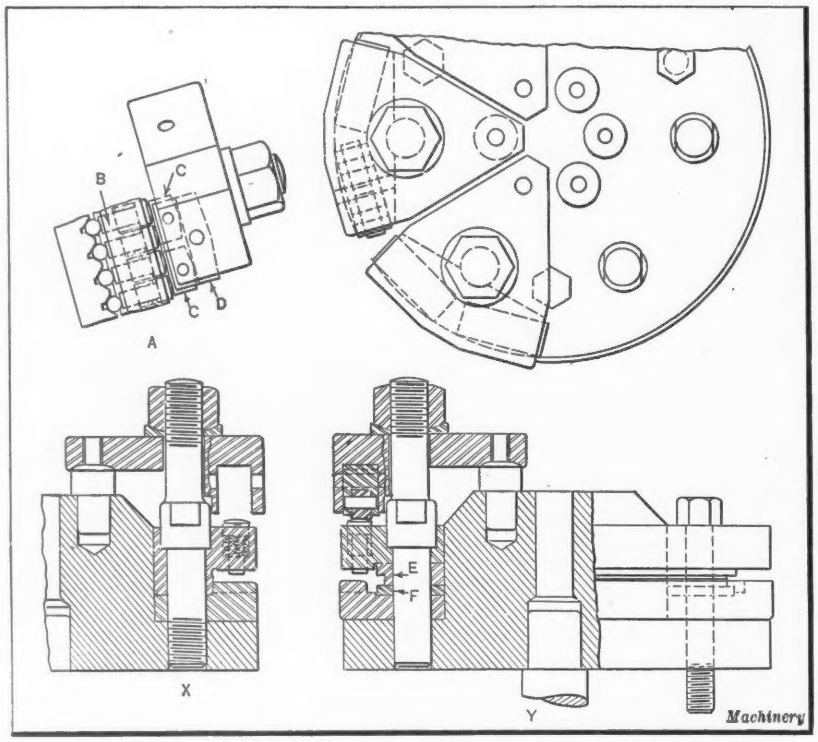


Fig. 13. Two Rotary Fixtures that carry the Roller Pins past the Milling Cutters during the End Slabbing Operation

with two rotary fixtures that rotate in opposite directions past two cutters. Eight pins are held in place by each clamp (see Fig. 13), the pressure of the clamping nut being transmitted to the work through vertical pins *B* and the swiveling equalizing blocks *C* and *D*. Each vertical clamping pin is provided with a coil spring to raise it from contact with the work when the clamping nut is loosened.

The pin is first placed in the V-ring of the left-hand fixture shown at *X* for slabbing the flats on one end, and then in the fixture at *Y* for milling the flats on the opposite end. In order that the flats on the second end be produced parallel with those on the first, the first flats are seated for the second operation in contact with parallel surfaces of rings *E* and *F*. The drive for these fixtures is taken through a standard knuckle-joint shaft on the left-hand end of the machine and delivered to a shaft that runs along the front of the table and drives each fixture through worm-gearing.

Coolant constantly plays on the work during this operation, and compressed air is used to clean chips from the V-groove rings of the fixture in replacing work. One man tends one of these machines, and an average production of 350 pins per hour is obtained. The tolerance on the pin diameter is 0.0005 inch, and is checked by means of a dial gage.

The pin is then carburized, cooled in the pot, heated, and hardened. Any burrs that may be on its surfaces are removed by tumbling after the hardening process. The pin is then finish-ground on a centerless grinding machine, after which it is taken to the Fitchburg grinding machine shown in Fig. 12 for grinding slight flats on one end, as shown at *Y*, Fig. 3, these flats assisting in lubricating the pin after the tappet has been assembled in the engine. In this last grinding operation the pin is carried between two grinding wheels while it is clamped in a rotating chuck. This chuck has thirty sockets in which the pins are placed as shown at *A*, Fig. 10, and clamped by pins *B* and *C*.

Before the work is carried to a position from which it will slide from the chuck, pin *B* is pushed against the work by a coil spring; this action takes place as a lug on pin *B*, sliding along flange *D*, reaches a position where the flange is machined away to increase the distance between it and ring *E*. Similarly, a clamping edge on pin *C* is pushed forward against the lower end of the work as the rear end of pin *C* rides over a raised portion on the front of flange *D*. A coil spring in the front end of pin *C* insures releasing of the work when the pin has passed the raised section of the flange. The clamping end of pin *B* has a V-groove in it. The production on this job averages 1000 pieces per hour.

The various tappet parts are brought to the assembly bench, where the roller is slipped into the jaw of the tappet, and the roller and tappet placed in a small arbor press equipped with a fixture having a plunger. The upper end of this plunger is slotted to receive one of the slabbed ends of the roller pin and guide the pin through the tappet and roller when the arbor ram descends on the upper end of the roller pin. Approximately 30,000 parts are handled per day in this department by 35 employes.

Fig. 14. Grinding the Flat Sides of the Tappet Rollers

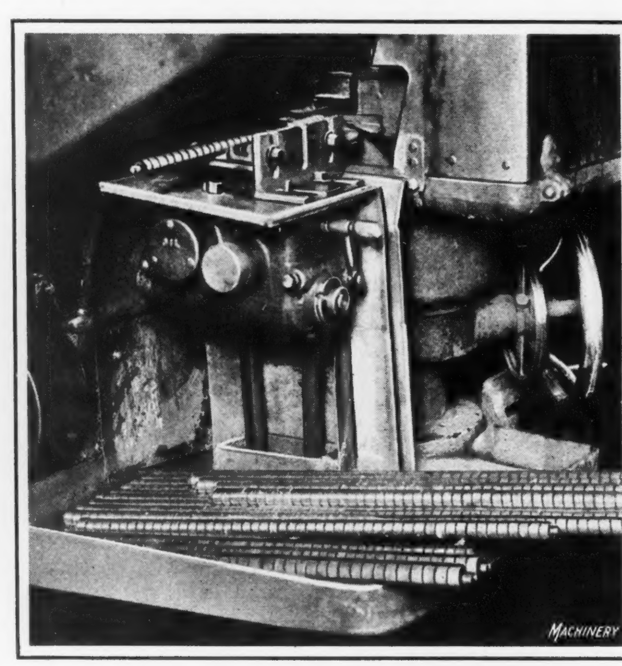
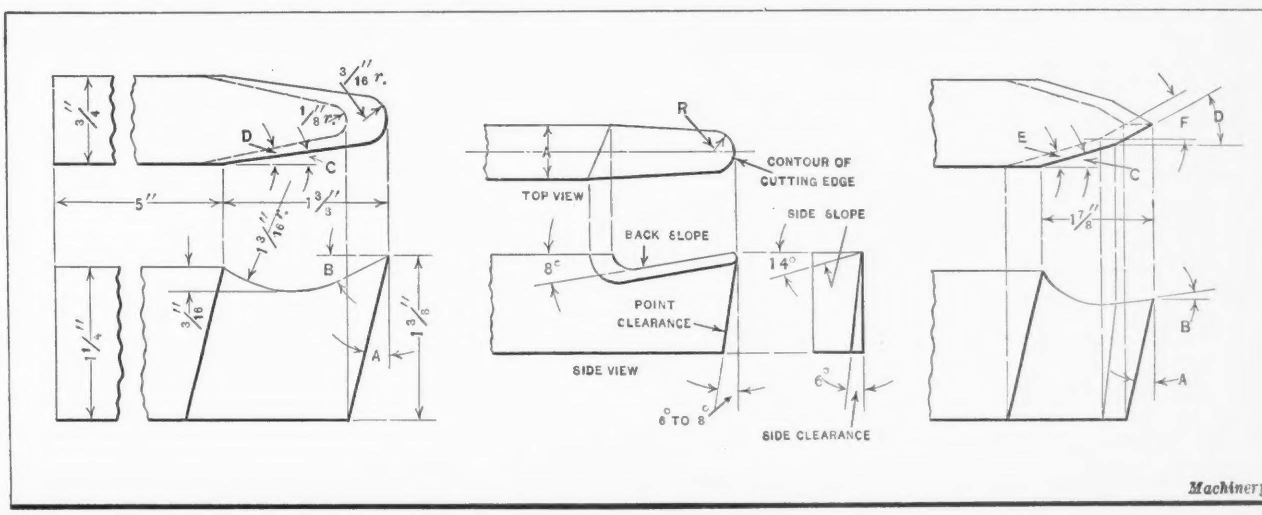


Fig. 15. Grinding Rollers on a Centerless Grinding Machine

Machining Monel Metal and Nickel

MONEL metal possesses individual machining qualities, the same as steel, aluminum, and brass. For the successful machining of monel metal, slight variations from the standard practice with respect to feeds, speeds, depths of cuts, and angular shapes of the cutting tools are necessary. On account of the toughness of the metal, cutting tools should be made from the best grade of high-speed tool steel obtainable, and they should be ground with sharp cutting angles. The following information on the machining of monel metal is based on data obtained from the International Nickel Co., New York City. These instructions apply equally to the machining of malleable nickel.

For lathe work, two cutting tools have been developed that permit the use of high cutting speeds with a minimum of regrinding. The sharp cutting angles required are best obtained, without weakening the cutting edge, by grinding the tools with either a large top rake or a combined top rake and side slope. The tool shown in the view at the left-hand side of the illustration is ground with a 13-degree clearance angle *A* and a top rake or back slope angle *B* of from 19 to 23 degrees.



Turning Tools for Monel Metal

The nose is tapered gradually at an angle *C* of about 9 degrees from a plane parallel to the side of the tool, and the cutting edge is rounded with a 3/16-inch radius. The angle *D* is made about 12 degrees. The tool shown in the central view of the illustration is ground with a 6-degree clearance angle and a combined 8-degree top rake and 14-degree side slope. Both tools cut cleanly, and easily rid themselves of the long tough chip characteristic of monel metal. Either of these tools may be used according to the preference of the individual machinist.

Tool for Threading Monel Metal

The threading tool (shown at the right of the illustration), on account of its pointed cutting edge has a greater tendency to crumble. For that reason, it is ground with a smaller top rake angle *B* of 9 degrees, and a clearance angle *A* of 12 degrees. Angle *C* should be 18 degrees, angle *D*, 30 degrees (for standard V-threads), angle *E*, 17 degrees, and angle *F*, 33 degrees. The sides on the nose of the tool are ground at a gentle slope from top to bottom. The tool point may be ground for any standard thread.

For 3/8-inch and 5/8-inch tool bits, the clearance angle depends upon the position in which the tool is held, and should be made just large enough to preclude any possibility of rubbing the flank against the work. As most tool-holders, in themselves, furnish sufficient top rake for the tool, none is necessary for 3/8-inch tool bits. With 5/8-inch tool bits, a 4-degree side slope is found advantageous. For small work, tools with an offset nose should be used.

Among the several high-speed steels that have given satisfactory results in cutting monel metal are the "Rex AA" (made by the Crucible Steel Co. of America) and "OOOL" (made by Peter A. Frasse & Co.). Directions for heat-treating these steels are furnished by the manufacturers, and the best results are obtained when these directions are carefully followed.

It has been found that tempering the tool properly after the initial hardening increases the life of the cutting edges. Tempering relieves the strain in the metal and gives it a tough rather than a hard cutting surface. This has been found beneficial, as monel metal is a tough rather than a hard metal. For shops with facilities at hand for heat-treating high-speed tool steels, the following procedure has given good results: First raise the temperature slowly to 1800 degrees F. (yellow heat) and then raise the temperature quickly to 2200 degrees F. (white heat) and cool the tool by plunging it into fish oil. Draw the temperature at 1000 degrees F., and allow the tool to cool slowly in a closed box. This procedure is used for high tungsten steels.

In machining, the essential difference between cast and rolled or drawn monel metal is that of structure and outside surface. Cast monel metal, similar to most sand castings, has a particularly tough outer skin, which subjects the cutting edge of the tools to a rather severe strain. For this reason when monel metal castings are being machined, the tools will give better results if they are made more blunt than recommended in the preceding paragraphs. A tool of this kind has less tendency to cut cleanly, but is stronger and withstands better the hard knocks encountered in cutting the skin of the casting.

After the skin has been removed, no trouble is encountered in cutting the more uniform metal underneath. Slightly slower cutting speeds are also necessary for cast monel metal. Rolled and drawn forms of monel metal, owing to their more homogeneous structure, are somewhat easier to machine than cast monel metal. The chip is longer and tougher, and higher cutting speeds may be used with good results.

The accompanying table of cut, feeds, and speeds is based on the experience of a number of firms that make a business of machining monel metal, and may be used to determine, in

a general way the proper speed for a given cut and feed. It will be noticed that a good average speed of 60 feet per minute with a ⅛-inch cut and a 1/32-inch feed should be used for cast monel metal. Likewise, an average speed of 70 feet per minute with a ⅛-inch cut and a 1/32-inch feed should be used for rolled monel metal. For better finished surfaces, lighter cuts at higher speeds may be taken.

Drilling Operations

Monel metal may be drilled at a reasonable speed and feed with both carbon steel and high-speed steel drills. From a number of tests it has been determined that apparently no advantage is gained by departing from the standard twist drill cutting and clearance angles furnished by the majority of drill manufacturers.

Carbon steel drills may be used economically at low speeds. The Union Twist Drill Co. found in a number of tests on carbon steel drills that the drills would stand up the longest and produce the most holes by using a peripheral cutting speed of from 20 to 25 feet per minute with a feed of 0.005 inch per revolution. This company recommends, however, that the tools always be kept sharp, as monel metal will show a rough surface when the cutting edge of the drill becomes worn. The cutting clearance of the standard drills made by this company were found satisfactory.

The Lincoln Twist Drill Co. recommends that a peripheral cutting speed of about 50 feet per minute with a feed of 0.003 inch per revolution be employed for monel metal. The Detroit Twist Drill Co. found that the straight-flute 18-degree spiral drills that it makes especially for brass drilling did not give as good results as its standard twist drills. Tests made by this company indicated that its high-speed drills with a 28- to 32-degree helix angle with a regular point having a slight back taper, to eliminate the gumming of the material on the margins, were satisfactory for use on monel metal, when regularly tempered and run at a peripheral cutting speed of 40 to 50 feet per minute, using heavier feeds than those employed for steel drilling.

Reaming Monel Metal—Milling

For reaming monel metal, it has been found that a slow speed of from 10 to 15 feet per minute gives good results. Reamers with spiral flutes should be used, when possible, and slow feeds employed. If too large a cut is taken at a high speed, monel metal is likely to tear and wedge between the cutting edges of the reamers. Reamers made from high-speed steel give better results on monel metal than those made from carbon steel.

The principle of employing sharp cutting angles for machining monel metal may also be applied to milling cutters. Cutters should always be made from high-speed steel. The tooth spacing will vary according to the diameter and kind of cutter. For plain milling cutters, teeth should be ground at a slight taper, widest at the cutting edge, to prevent binding and possible tearing of the metal. An under-cut or rake on the teeth of milling cutters has been found beneficial for milling monel metal.

In one plant where large monel metal castings are machined on a No. 5 Cincinnati milling machine, an 8-inch milling cutter with ten inserted teeth of 1¼- by ⅜-inch high-speed steel, is used successfully. The blades are set in the body so that the rake angle that the face of the blade makes with a radial line is 15 degrees. The cutter is run at a speed of 16 revolutions per minute, taking a cut ¼ inch deep with a feed of 4½ to 4⅝ inches per minute.

Another firm uses a side milling cutter, 4 inches in diameter, ground with a 15-degree under-cut on the teeth. This firm takes a 3/16-inch cut with a table travel of 2½ inches per minute at a speed of 100 feet per minute. The National Twist Drill & Tool Co., in conducting tests to determine the machineability of various metals, including monel metal, found a decided advantage was gained by using tools with a high rake angle.

For general practice in milling monel metal, an average speed of from 70 to 80 feet per minute should generally be used with a ⅛-inch cut and from 0.005 to 0.010 inch feed per revolution, though the depth of cut and the surface speed depend a great deal upon the strength of the milling machine. The Union Twist Drill Co. finds no advantage is gained, in milling monel metal, by departing from its standard cutting clearances. This company found that the metal wore away the cutting edge slightly more than steel and would very quickly show a rough surface when the cutting edges of the milling cutters became dull. Hence the fact is emphasized that cutters should always be kept sharp.

Tapping

One of the chief difficulties in tapping monel metal is the tendency for the tough chip to stick in the flutes of the tap. For that reason, it is advisable to use taps designed with two or three lands and shallow flutes so as to obtain additional strength. A lip should be ground back of the cutting edges, in order that the chip may better curl through the flutes and clear itself.

When tapping completely through monel metal, it is good practice to grind the cutting edge at an angle of from 10 to 15 degrees to the axis of the tap, with a plugging, or chamfering, four or five threads. The best all-around cutting speed for tapping monel metal lies between 15 and 20 feet per minute. Taps should be watched carefully to avoid overheating. They may be made either from high-speed or carbon tool steel. The Greenfield Tap & Die Corporation found, after a number of experiments, that its stock "gun tap," lends itself admirably to tapping monel metal. This company's stock taps are designed with a 20-degree hook back from the cutting edge and with a plugging or chamfering of four threads. Cutting is done by the first few full threads, the remaining thread serving to size the thread and maintain the lead.

Precision Grinding

Methods of grinding monel metal do not differ from the practice followed with steel. When the finishing operation is to be grinding and the material to be removed is not too great, all the work may be done on a grinding machine, a roughing and a finishing operation being used. Grinding wheels recommended by the leading manufacturers for use on monel metal can be depended upon to give good results.

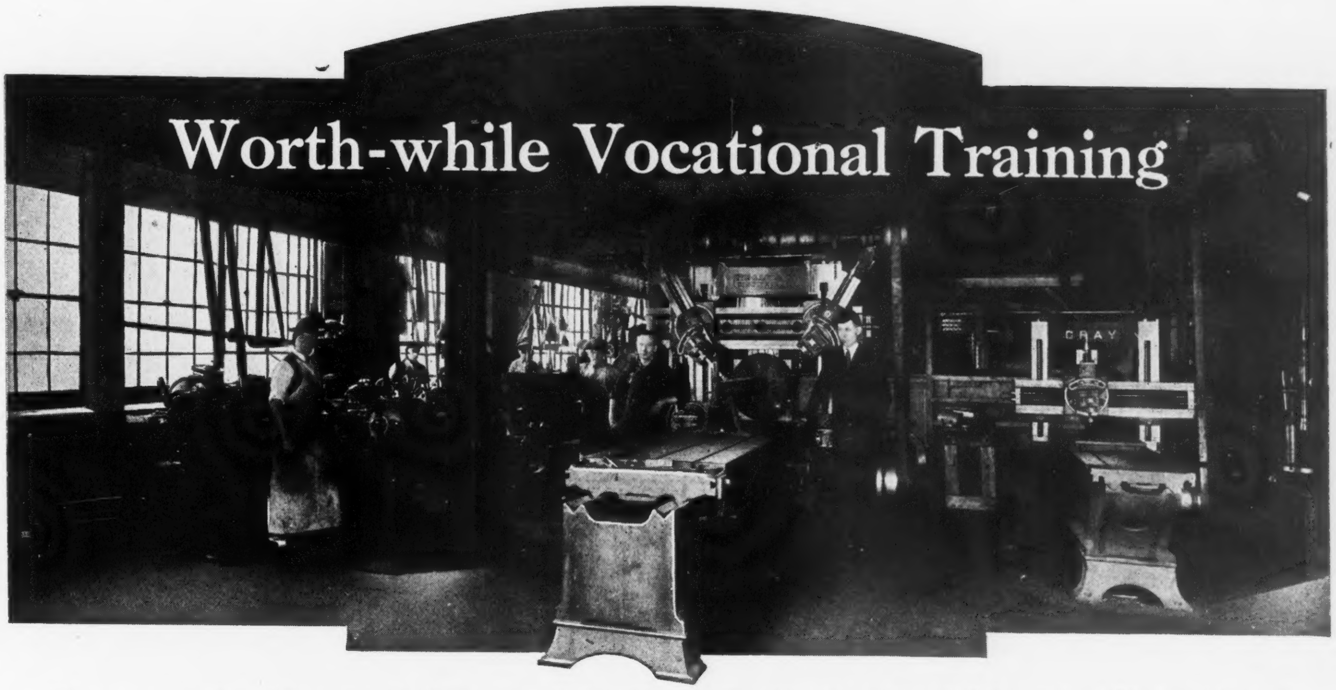
* * *

Experiments in the operation of internal-combustion engines with motor benzol, conducted by the Department of the Interior at the Experiment Station of the Bureau of Mines at Pittsburg, indicate that this type of fuel may serve as a satisfactory substitute for gasoline, when refined by the use of sulphuric acid or silica gel.

FEEDS AND SPEEDS FOR TURNING MONEL METAL

Cut (inches)		1/64		1/32			1/16			1/8				1/4		
Feed (inches)...........		1/64	1/32	1/64	1/32	1/16	1/64	1/32	1/16	1/64	1/32	1/16	1/8	1/32	1/16	1/8
Cutting Speed in Ft. per Minute	Cast	150	120	100	90	75	85	70	50	75	60	45	40	50	40	30
	Rolled	170	140	115	100	85	95	80	55	85	70	50	45	55	45	35

Worth-while Vocational Training



Features of the Educational Program of the Grand Rapids Vocational School for Giving Future Machinists and Draftsmen a Well-rounded Knowledge of Their Trade

By GEORGE B. FRAZEE, Principal, Grand Rapids Vocational School, Grand Rapids, Mich.

SOCIETY for hundreds of years has recognized the necessity of conducting educational institutions for teaching the professions, but it is only within a recent period that any attempt has been made to give specific training to boys and girls who are not to attend college. Courses of study in the elementary and high schools have generally been prepared with the thought in mind that the student will either enter college or will follow a business career, and little attention has been paid to the fact that a large percentage are ambitious to learn a trade. Consequently, in the average high school the future skilled mechanic is taught little that will be of direct value to him in earning his livelihood.

Manual training has been instituted in most city schools during the last twenty years with a view to assisting the student in determining the work for which he may be naturally fitted, and this has been a desirable addition to school work. There is no question but that the hardest problem of the average ambitious boy is to determine the profession or trade for which he will train himself, and every possible assistance should be given to help him make this decision intelligently. However, it has been recognized of late years that something more than manual training should be given to the boys and girls who in later life will be called upon to work with their hands as well as their brains, and so the federal and various state governments have cooperated in founding vocational schools. In order to acquaint the metal-working field with the extent of the practical education which may be given in schools of this type, this article outlines the program followed by the Vocational School in Grand Rapids, Mich., in training future machinists and mechanical draftsmen.

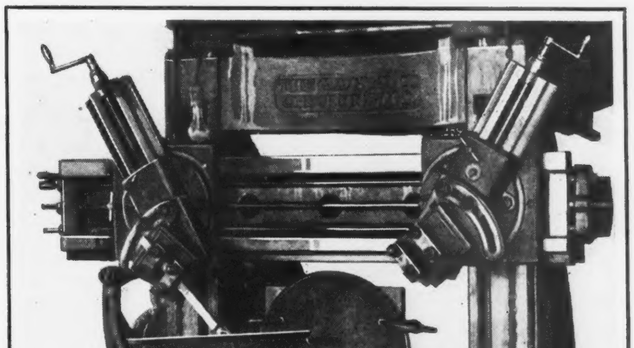


Fig. 1. Planing the Face and Angular Edges of a Drilling Machine Column

Four different types of regular students attend this vocational school:

First, the "all-day vocational" student, who has selected the trade he wishes to train himself for. This student attends school six hours a day, five days a week. Half of this time is taken up in learning the shop or laboratory work of his trade, and the other half is spent in studying related subjects.

Second, the "continuation" student, from sixteen to seventeen years old, who wishes to go to work, even though he has not finished high school. This student must attend the vocational school eight hours a week, according to the Michigan state law. Continuation students from fourteen to sixteen years of age are also accepted, provided they have completed the eighth grade.

Third, the "part-time" student of any age above sixteen, who may already be a skilled workman and wants to know how to run some particular machine or to handle some other phase of his trade that he has not been taught. The students belonging to this group may attend the school at their own convenience.

Fourth, the "night-school" student, who is not taught anything that is not closely related to his work in the day-time.

Besides these regular students there are rehabilitation men who may have been injured in the war or crippled otherwise, and who are given federal or state aid.

Cooperation of the National Metal Trades' Association

In establishing this school, it was recognized that maximum results could only be

obtained with the cooperation of the manufacturers in Grand Rapids, and so the various business associations were each asked to appoint a committee to work in conjunction with the school faculty. The National Metal Trades' Association especially has cooperated wholeheartedly by appointing a committee which has not only been of great value in purchasing shop equipment, but also in correlating the work taught to machine shop apprentices in the various plants, with the studies that these apprentices are pursuing in the vocational school.

Boys who contract with a manufacturer to learn a trade are required to attend the vocational school eight hours a week; they study such subjects in the school as will equip them for positions as foremen and superintendents rather than simply as journeymen. These are considered continuation students. The work taught in the shop during the four years of apprenticeship is divided into eight units of 1350 hours each, and while the apprentice pursues these units, he is being taught in school certain subjects, as follows:

First Unit

Shop: Tool-crib instruction, in which the apprentice is taught the system of handling tools and supplies, proper methods of grinding tools, how to cut off stock, etc.
School: Free-hand drawing and machine shop arithmetic.

Second Unit

Shop: Milling and drilling machines.
School: Geometrical drawing and algebra.

Third Unit

Shop: Shapers and planers, and tool dressing.
School: Geometrical drawing and algebra.

Fourth Unit

Shop: Preliminary lathe work.
School: Mechanical drawing and geometry.

Fifth Unit

Shop: Advanced lathe work and grinding.
School: Mechanical drawing and trigonometry.

Sixth Unit

Shop: Thread milling, gear-cutting, etc.
School: Odontics and mechanics.

Seventh Unit

Shop: Vise work and assembly of parts.
School: Perspective and isometric drawing and physics.

Eighth Unit

Shop: Machine erection, inspection methods, and work lay-out.
School: Tool design, applied mechanics, and cost study.

In addition to these studies, the student is instructed in general subjects, such as civics, so as to prepare him as well as the high school graduate, to meet the duties of a citizen. One of the features of the school is that individual instruction is given in all classes, so that the progress of the bright boy is not retarded by one less alert mentally.

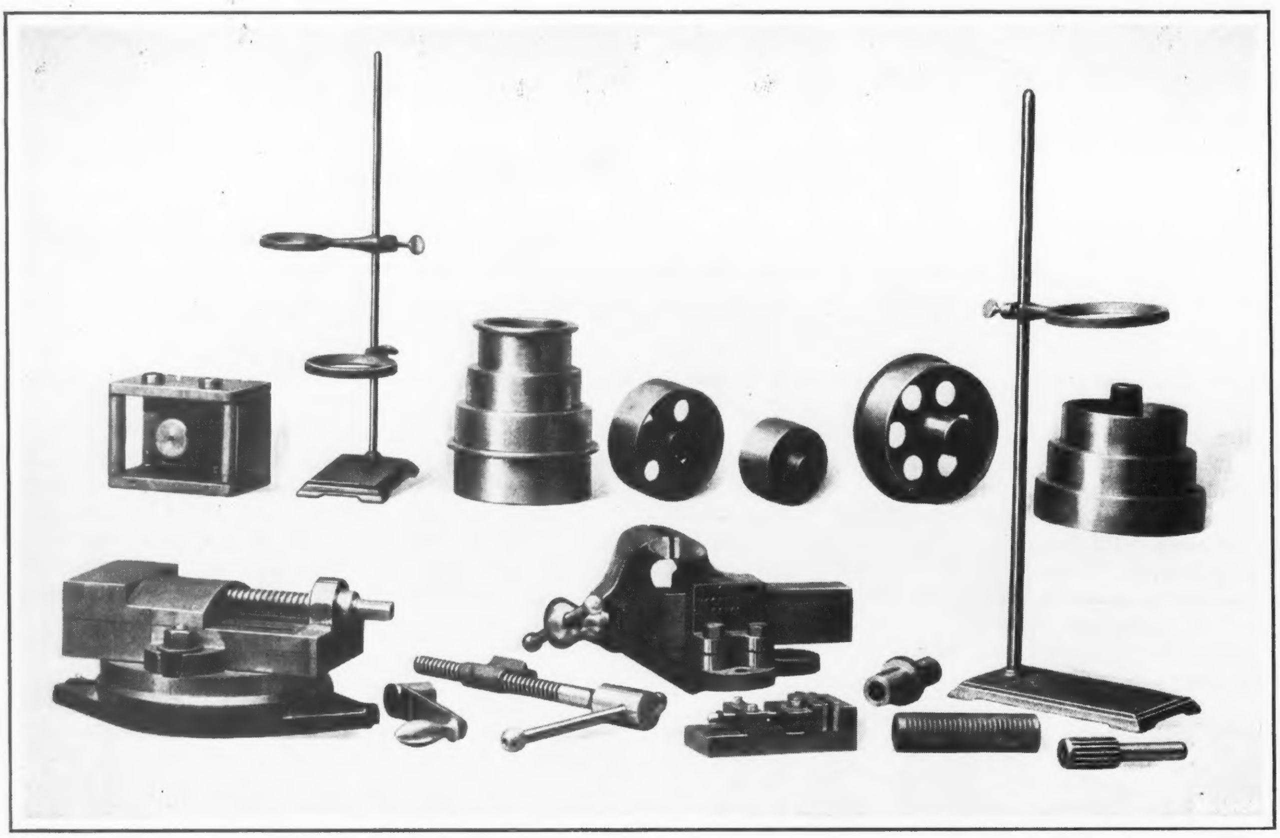


Fig. 2. Examples produced by Students specializing in Machine Shop Work

Shop Program for All-day Students

If the all-day student has passed the eighth grade, he is permitted to enter on a four-year machine shop course; otherwise he starts on a less thorough two-year course, because his preliminary education has not been sufficient for him to grasp the allied academic subjects taught to the four-year student. The work of the four-year student has been carefully planned in such a way that he becomes a capable operator of each machine before he is given instruction on the succeeding one. The purpose in doing this is to make the student a good operator of several machines, at least, in the event that circumstances require him to begin working before he completes the course.

From Fig. 4, which shows the schedule of work outlined for the four-year student, it will be seen that the instruction on the various machines is in the following sequence: Engine lathe, shaper and planer, milling machine, grinding machine, drilling machine, forge, and bench. A certain number of hours has been set as the standard time in which each operation should be satisfactorily done, and no matter how long it takes the student to do the operation, he gets

credit for the established time. By this method the boy who falls behind the schedule has an incentive to catch up to it. Some boys have come to school ahead of time and remained after hours in order to make up the time.

The succession of different operations in each block is not strictly adhered to, because only parts having a practical use are made by the boys, and it is not always convenient to follow the schedule closely on account of the changing nature of the work. One of the early jobs on the lathe consists of machining planer bolts, which gives practice in turning, facing, and threading. Another typical elementary job is the making of planer clamps, which involves shaping parallel and angular surfaces, drilling, chipping, and filing. Everything that the boys make is put to practical use either in this school or in the manual training department of the high schools. It has been found that the average boy takes a greater pride and interest in what he is making if he knows that the part will later be used instead of being scrapped. The schedule shown in Fig. 4 is made out in duplicate, and as the boy completes each block, the original is torn off along the perforations and given to the boy as a certificate of work accomplished.

Training for Continuation Students

It is, of course, impossible to plan such an intensive training for the continuation student. However, he is given instruction in the operation of the different machines, and an effort is made to interest him in apprenticing himself to some manufacturer. As these students are admitted to the vocational schools provided they have passed the eighth grade or are sixteen years old, many of them have not had manual training, and to such students the vocational school supplies this training.

If a continuation student selects the machine shop course, he is given a three-months' trial, and at the end of that period if the instructor concludes that the boy will never become a good machinist, he recommends that the boy be transferred to some other department. However, should the boy insist that he wants to learn this particular trade, he is given another three-months' trial. At the end of the second period, if the boy seems to have no natural inclination for the work, he is persuaded to take up some other trade.

The aim of the two-year course is to make the student a mechanic capable of operating all standard machine tools, but within this time it is impossible to give him the general foundation necessary for a high-class foreman or superintendent. Before the student can enter upon the four-year course, he is interviewed by the principal to determine whether or not he has sufficient ambition to carry the course through with the intention of becoming a foreman or superintendent, as otherwise he is not permitted to take it. In fact, all students are interviewed in order to ascertain whether they have intelligently selected the particular trade they want to take.

Shop Equipment and Work Produced

Everything is done to make the school-room as nearly like the shop as possible, as will be evident from the heading illustration. All tools are lent to the boys from a tool-crib under a checking system, and each boy serves a certain amount of time in the crib, so that he may learn the value of the tools and the necessity of keeping records concerning their whereabouts. The machine equipment is unusually good for a school, consisting of standard up-to-date machine tools which were mainly purchased at government sales for about 15 per cent of the actual value. This equipment includes 36- by 36-inch by 12-foot, and 24- by 24-inch by 6-foot planers; eighteen engine lathes of from 12 to 18 inches in swing; three plain and universal milling machines; a hand miller; a Lo-swing lathe; a shaper; a screw machine; universal, cylindrical, and cutter grinding machines; drilling machines; arbor presses; and power hacksaws. In addition to these machines, there is a gas-hardening furnace, two forges, and several bench furnaces. Different makes of the same type of machine have been selected in general so that the student will become familiar with more than one make.

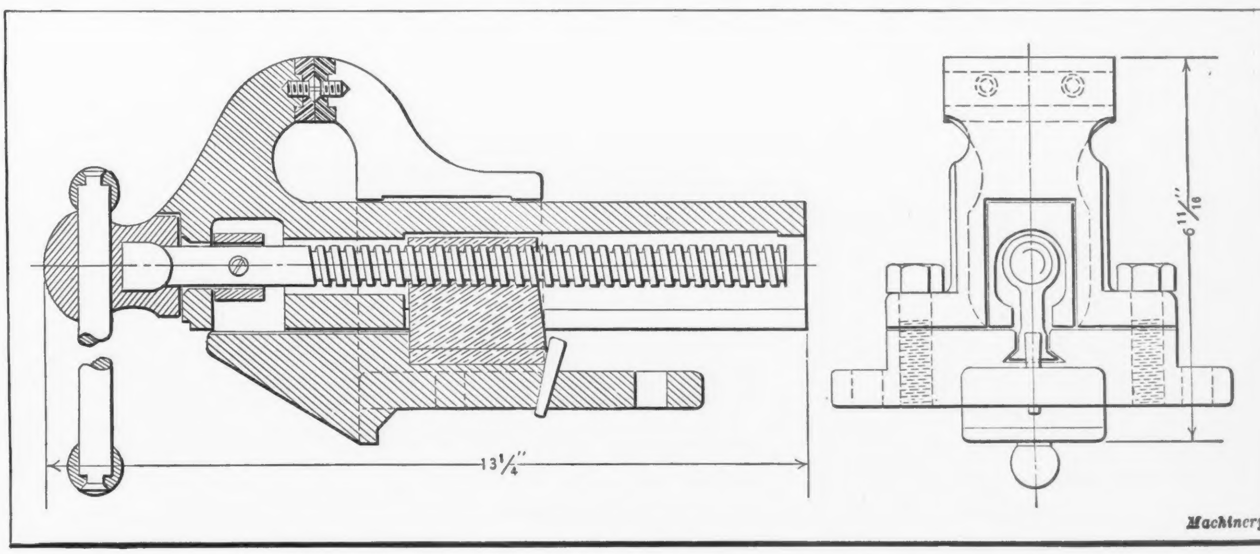


Fig. 3. Construction of Bench Vise designed in the Drawing-room and built in the Machine Shop

With such high-class equipment, a large quantity and high quality of work can be produced. A typical order handled in the school is one for six 14-inch sensitive drilling machines which are being built for the manual training schools. Fig. 1 shows a column for one of these machines being finished on the large planer. In order to reduce costs, the patterns for such jobs are frequently borrowed from vocational schools in neighboring cities.

Owing to the number of schools that have recently been erected in Grand Rapids, there has been a large volume of work passing through the shop, as the school endeavors to produce all parts that it is possible for the boys to make. One job consisted of boring and threading 500 pipe tees for railings, and many bench vises of the design shown in Fig. 2 have been made. As will be apparent by reference to Fig. 3, this vise is an excellent unit of parts for machine shop students to make.

Other interesting examples of work done are shown in Fig. 2, as, for instance, the machine vise and the small jig directly above it. A large amount of repair work is also handled in the shop, as well as some outside jobs. Anything may be purchased by the boy making it at the actual cost of the raw material, but no attempt is made to sell on the public market. No mere exercises are used in the machine shop, as it is contended that the use of such exercises makes the boy feel that his work is of no value and tends to destroy the shop atmosphere.

Grand Rapids Vocational School
Machine Shop
Block X.—Bench Work

	Hrs.
1. Layout	
2. Chipping and Filing	
3. Scraping	
4. Threading with Die	
5. Hand Reaming and Tapping	
6. Riveting	
7. Babbitting	
8. Assembling	
9. Fitting Keys and Gibs	
10.	
11.	

Name
Date | Grade
Technical Skill
Application

Grand Rapids Vocational School
Machine Shop
Block IX.—Forge

	Hrs.
1. Dressing Cold Chisel	
2. Hardening and Tempering	
3. Forging Lathe Tool	
4.	
5.	
6.	
7	
8.	
9.	
10.	
11.	
12.	

Name
Date | Grade
Technical Skill
Application

Grand Rapids Vocational School
Machine Shop
Block VIII.—Drill Press

	Hrs.
1. Layout Work	
2. Plain Drilling	
3. Counter Sinking	
4. Counter Boring	
5. Reaming	
6. Use of Tapping Attachment	
7. Jig Drilling	
8. Precision Drilling	
9.	
10.	
11.	

Name
Date | Grade
Technical Skill
Application

Grand Rapids Vocational School
Machine Shop
Block VII.—Grinder No. 2

	Hrs.
1. Straight Grinding	
2. Taper Grinding	
3. Tool Cutter Grinding	
4. Grinding in Lathe	
5. Lapping	
6. Internal Grinding	
7	
8.	
9.	
10.	
11.	
12.	

Name
Date | Grade
Technical Skill
Application

Grand Rapids Vocational School
Machine Shop
Block VI.—Grinder No. 1

	Hrs.
1. Plain Grinding	
2. Tool Bit Grinding	
3. Surface Grinding	
4. Center Grinding	
5.	
6.	
7.	
8.	
9.	
10.	
11.	
12.	

Name
Date | Grade
Technical Skill
Application

Grand Rapids Vocational School
Machine Shop
Block V.—Milling Machine No. 2

	Hrs.
Gear Cutting	
(a) Spur	
(b) Bevel	
(c) Spiral	
(d) Gear Hobbing	
2. Fluting	
(a) Straight	
(b) Spiral	
3. Precision Work	
(a) Drilling	
(b) Boring	
(c) Counter Boring	

Name
Date | Grade
Technical Skill
Application

Grand Rapids Vocational School
Machine Shop
Block IV.—Milling Machine No. 1

	Hrs.
1. Plain Milling	
(a) Vertical	
(b) Horizontal	
(c) Angle	
(d) End	
(e) Side	
(f) Face	
2. Indexing	
3.	
4.	
5.	
6.	

Name
Date | Grade
Technical Skill
Application

Grand Rapids Vocational School
Machine Shop
Block III.—Shaper and Planer

	Hrs.
1. Work in Vise and Clamps	
2. Plane Surface Work	
3. Side Cutting	
(a) External	
(b) Internal	
4. Angle Work	
5. Template Work	
6.	
7.	
8.	
9.	
10.	

Name
Date | Grade
Technical Skill
Application

Grand Rapids Vocational School
Machine Shop
Block II.—Engine Lathe No. 2

	Hrs.
1. Work in Chuck	
(a) Drilling (b) Boring	
(c) Internal Taper Cutting with Compound Rest	
(d) Tapering with Taper Attachment	
2. Thread Cutting	
(a) Internal and External	
(b) Right and Left Hand	
(c) Multiple	
3. Face Plate Work	
4. Turning with Center Rest	

Name
Date | Grade
Technical Skill
Application

Grand Rapids Vocational School
Machine Shop
Block I.— Engine Lathe No. 1

	Hrs.
1. Facing or Squaring Ends on Centers	
2. Plain Turning on Centers	
3. Shouldering	
4. Chamfering	
5. Knurling	
6. Filing	
7. Taper Turning (off Set Tail Stock)	
8. Polishing	
9.	
10.	

Name
Date | Grade
Technical Skill
Application

Fig. 4. Schedule of Work planned for the Four-year All-day Machine-shop Student

As previously mentioned, both the all-day and the continuation student spends one-half of his time in pursuing academic subjects relating to the trade that he is learning. For a boy taking machine shop work, these subjects include mechanical drawing, shop mathematics, physics, chemistry, civics, English, and general science. The all-day student takes mechanical drawing instruction three hours a week, being taught how to make simple sketches and detail parts that he may be actually machining in the shop. The course in physics comprises practical experiments with pulleys and other parts common in the shop, and in the chemical laboratory an examination into the properties of lubricating oil and similar tests are conducted.

Cast-iron samples are sometimes broken in the general science course and studied by the boys. The boys are taken to a foundry, and the elementary principles of foundry practice explained. The English course is made as practicable as possible, being adapted to the particular subject the student is taking, and planned to make him familiar with the nomenclature of his trade. A class in industrial history is also conducted to give the machine shop student a knowledge of the history connected with the development of machine tools.

The Mechanical Drawing Course

For all-day students in mechanical drawing there is the two-year block schedule (Fig. 5), which is followed in the same manner as the schedule devised for the all-day machine-shop student. The first drawing exercises are planned to familiarize the student with the use of his instruments and the principles of mechanical drawing, while from Block VI on, the work is of a practical nature. Drawings are not made from models but are actually designed, such parts as cams, pulleys, and gears being proportioned and their strength calculated from rules and formulas given in MACHINERY'S HANDBOOK. The student is early taught tracing in order that he may at least obtain a position as a tracer, should it become necessary for him to discontinue the course. Before any drawing is started, the student is obliged to submit a free-hand sketch of the drawing that he contemplates, in order to impress upon him the value of the ability to sketch well.

Much of the work put through the drawing-room is also actually used. For instance, a few of the lathes purchased for the machine shop were originally built as single-purpose machines and had to be equipped with standard cross-slides and other parts before they could be used by the machine shop students. These parts were designed in the drawing-room, as was also the bench vise illustrated in Fig. 3. A number of mechanisms have been developed from patent specifications, which give excellent practice in design, and drawings have also been made for outside concerns. Occasionally a manufacturer in the city sends to the school for a boy to help out on a rush job, and pays the student for his work. The boy is given school credits for his outside work when he returns.

All drawings in the school are made on standard size sheets and numbered according to the system of drawing-rooms in general use. A blueprinting machine and washing tank permit of giving instructions in the making of prints, and the more advanced students are taught the use of the slide-rule. All-day drawing students spend three hours a week in the machine shop and one-half of their time in academic courses, such as mathematics and physics. Continuation students in the drawing-room, of course, can only be taught the use of the instruments, detail drawing, and tracing, because of lack of time.

Is Vocational Education Successful?

Questions as to the success of vocational training are answered in Grand Rapids by pointing out the cooperation of the manufacturers, the constant request for boys to work

at the trade taught them by the school, and the fact that the school cannot care for all applicants. A five-story building has just been erected to accommodate a larger student body. This new building contains a gymnasium and an auditorium. Lectures are given on personal hygiene and health, and each student is given a physical examination. Much of the success of the vocational school is due to the personnel of the faculty; only teachers who are at least eighth-grade graduates, have worked five or more years at their trade after completing their apprenticeship, and who could fill positions as foremen are accepted.

The teachers must also be congenial and interested in their students, and are impressed with the fact that because the continuation students lose from $2 to $4 a day in attending this school, they are entitled to expect the amount of money lost to be returned to them in educational value. They must also recognize the fact that a mechanic is fully as useful a citizen as a professional man, and that he can and has a right to enjoy the same social advantages. The principal makes it a point to visit each shop and school-room at least once a week and talk to the individual boys and girls. Many trips are also made by the principal to the various manufacturing plants, so that he may maintain a close personal contact with the manufacturers and continue to enjoy their cooperation. He is only responsible to the Board of Education and the superintendent of schools, for the work of the school, and not to any other school authorities.

Other Departments of the School

From the foregoing it may be thought that the machine shop and drawing-room constitute the most important departments of the school, but this is not true, as other departments are fully as active. Practically all such furniture as cabinets, tables, and chairs for new and old schools are made in the woodworking shop. The printing department is equipped with two linotype machines, a Miehle four-roll cylinder press, a Cleveland folder, etc., and handles all the printing done by the school. The forms reproduced in Figs. 4 and 5 are excellent examples of the work turned out by the printing department.

There is also a school for automobile mechanics in which cylinders are reground, and automobiles repaired in general. Students for this shop are obliged to take a short preliminary course in machine shop practice, so that they will realize the importance of accuracy in this work and will learn to operate the lathe, grinding machine, and drilling machine. Classes in foremanship are also conducted in evening sessions at the school and during working hours in various industrial plants. Girl students are taught cooking, dressmaking, millinery, and business subjects.

Naturally difficulty is experienced in making some continuation students attend school the required eight hours a week, because the students lose money in going to school and they may not be interested in learning a trade. However, such students are firmly dealt with by threatening to cancel their working permits if they do not attend regularly and show an interest in their studies. An accurate record is kept of the work and attendance of each boy, and in case he is constantly tardy or absent he is compelled to give an explanation to the principal. These records are also of value in case the boy applies for a job and the prospective employer calls up on the telephone to ascertain his fitness to fill the position he desires.

* * *

To emphasize the importance of foreign trade in the daily life of every American, the National Foreign Trade Council, 1 Hanover Square, New York City, has just published a booklet entitled "Our Imports and Who Use Them." This booklet makes clear many of the common misconceptions relating to import trade.

Grand Rapids Vocational School
Drafting
Block X.—Gears and Design

	Hrs.
1. Developement of Teeth	
2. Spur Gears and Racks	
3. Bevel Gears	
4. Ring Gears	
5. Worm and Wheel	
6. Gear Trains	
7. Odontograph Methods	
8. Simple Original Designs	
9.	
10.	
11.	
12.	

Name
Date / Grade
Technical Skill
Application

Grand Rapids Vocational School
Drafting
Block. IX.—Simple Designs From Hand Books

	Hrs.
1. Tight and Loose Pulleys	
2. Cone Pulleys	
3. Sheaves	
4. Double End Wrenches	
5. Spanner Wrenches	
6. Large and Small Wheels	
7. Eye Bolts	
8. Crane Hooks	
9. Chain and End Links	
10. Turnbuckles	
11. Tools	
12.	

Name
Date / Grade
Technical Skill
Application

Grand Rapids Vocational School
Drafting
Block VIII.—Cams

	Hrs.
1. Plate Cams	
2. Cylindrical Cams	
3. Cams with Links	
4.	
5.	
6.	
7.	
8.	
9.	
10.	
11.	
12.	

Name
Date / Grade
Technical Skill
Application

Grand Rapids Vocational School
Drafting
Block VII.—Sections and Developements

	Hrs.
1. Oblique Sections and Developements (5)	
2. Oblique Intersections and Developements (10)	
3. Triple intersections and Developements	
4.	
5.	
6.	
7.	
8.	
9.	

Name
Date / Grade
Technical Skill
Application

Grand Rapids Vocational School
Drafting
Block VI.—Details and Assemblies

	Hrs.
1. Simple Machine Parts (7)	
2. Complex Machine Parts (16)	
3. Assemblies with Details	
4.	
5.	
6.	
7.	
8.	
9.	
10.	
11.	

Name
Date / Grade
Technical Skill
Application

Grand Rapids Vocational School
Drafting
Block V.—Mechanical Drawing See Corresponding Plate

	Hrs.
1. Square Prism	
2. Cylinder	
3. Hexogonal Prism	
4. Square Pyramid	
5. Cone	
6. Square Prism and Hemisphere	
7. Cylinder and Cone	
8.	
9.	
10.	
11.	

Name
Date / Grade
Technical Skill
Application

Grand Rapids Vocational School
Drafting
Block IV.—Geometric Construction and Tracing

	Hrs.
1. Plate (10)	
2. Plate (11)	
3. Plate (12)	
4. Tracing on Paper and Cloth	
5.	
6.	
7.	
8.	
9.	
10.	
11.	

Name
Date / Grade
Technical Skill
Application

Grand Rapids Vocational School
Drafting
Block III.—Forms of Standard Machine Parts

	Hrs.
1. Plate (6)	
2. Plate (7)	
3. Plate (8)	
4. Plate (9)	
5.	
6.	
7.	
8.	
9.	
10.	
11.	
12.	

Name
Date / Grade
Technical Skill
Application

Grand Rapids Vocational School
Drafting
Block II.—Standards and Conventions

	Hrs.
1. Plate (4)	
2. Plate (5)	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	
11.	
12.	

Name
Date / Grade
Technical Skill
Application

Grand Rapids Vocational School
Drafting
Block I.—Exercises

	Hrs.
1. Plate (1)	
2. Plate (2)	
3. Plate (3)	
4.	
5.	
6.	
7.	
8.	
9.	
10.	
11.	
12.	

Name
Date / Grade
Technical Skill
Application

Fig. 5. Program followed in the Two-year Course in Mechanical Drawing

MILLING FIXTURES AND DRILL JIG FOR FAN BRACKET

By D. D. WELLS

The milling fixtures and the drill jig described in this article are employed in the production of fan brackets of the design shown by the dot-and-dash lines in Fig. 1. The fixture shown in this illustration is used for the first machining operation on the bracket, which consists of milling the base or face *M*; this serves as a locating surface for succeeding operations.

It will be noted that the milling fixture is of the string type with separate clamping devices for holding each piece. The fixture is designed to hold five brackets, but for clearness only four of the clamping plugs are shown in the upper view, and three in the lower view. It is an easy matter for the workman to load and unload this type of fixture while the machine is in operation.

The cast-iron base *A* of the fixture has a relief cut in the bottom to provide space for the heads of the clamping plugs *B* which extend up through elongated holes in the base. Sufficient clearance is provided to permit the clamping plugs to draw the work against the locating pins *F*, when actuated by the clamping screws *C* which are piloted on each side of the clamping plugs. The object of having two pilots, or bearing surfaces, for the clamping screw is to prevent any possibility of this member becoming locked. On the end of the clamping plug is pressed a hardened and ground retaining collar *D*, which is held in place by a headless setscrew *E*. Collar *D* gives a good clamping surface for the work, and also prevents dirt and chips from falling into the elongated hole in the base of the fixture.

The stud *G* in the top of clamping plug *B*, and the C-shaped washer *H*, are used to clamp the work down on the base. In loading the fixture, the cored hole in the work is placed over the clamping plug. The work is then drawn back by means of the clamping screw *C* until it is brought up against the locating pins *F*. The C-shaped washer *H* is then slipped over the end of stud *G*, and the nut *J* is tightened. The distance across the flats on the hexagonal nut *J* and the clamping screw *C* is the same, so that one wrench can be used for both. The milling cutter is set in the proper position by means of a hardened block *K*, which is attached to one end of the fixture base by means of two fillister-head screws. Two keys *L*, set into grooves planed in the bottom of the fixture, serve to locate the fixture on the milling machine table.

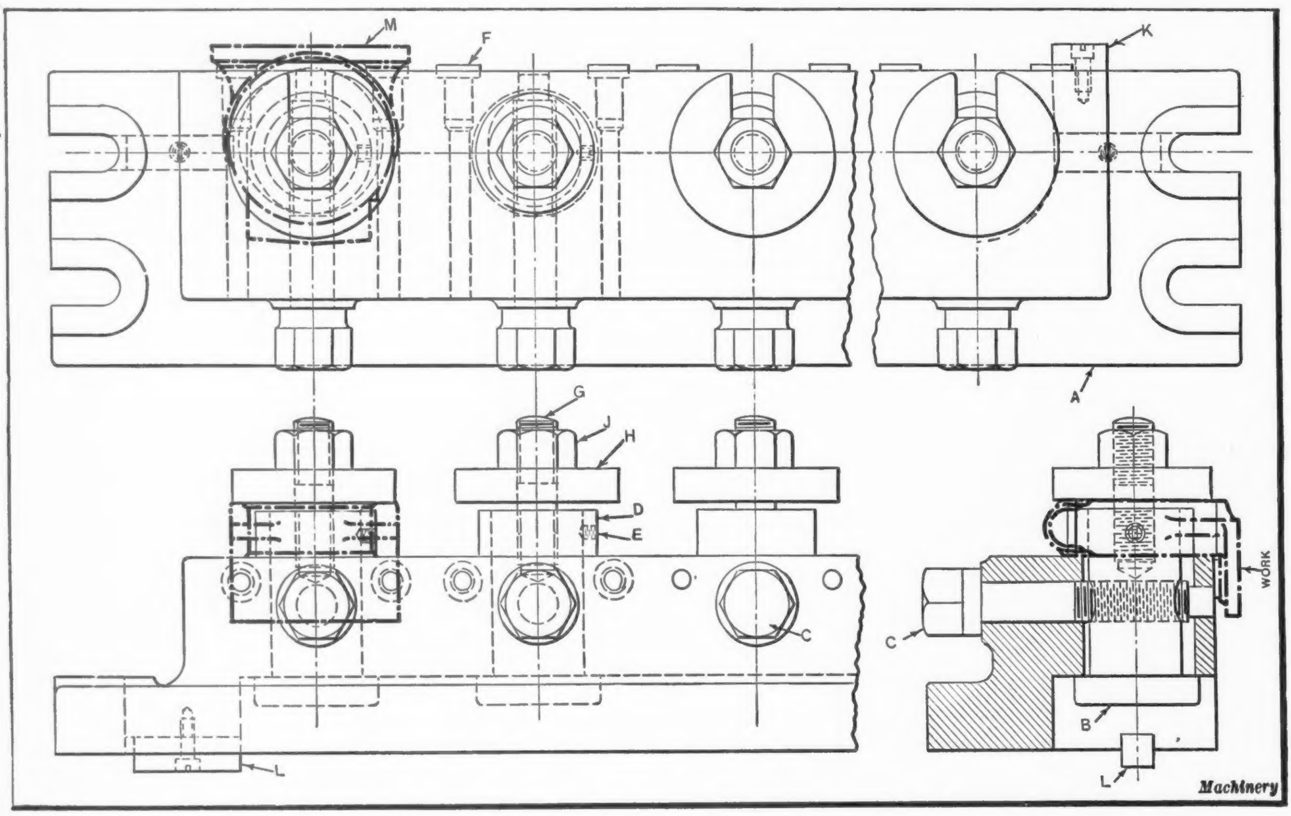


Fig. 1. Line Milling Fixture for Fan Bracket

Jig for Drilling Base of Bracket

After surface *M* is milled and the large hole in the bracket reamed to size, the smaller holes are drilled in the base by the use of the drill jig shown in Fig. 2. One movement of the cam-lever *C* serves to locate and clamp the work in the jig ready for the drilling operation. Many tool designers object to cam clamping fixtures on the ground that the vibration of the machine loosens the cam and allows the work to become loose in the fixture. This does not happen, however, if the cam is properly designed and in the correct position when the work is clamped in place.

The work is slipped over the locating plug *B* which extends through the elongated hole in the base *A*. The elongated hole permits the locating plug to drop down far enough so that the work will clear the part of the jig in which the drill bushing is mounted. The retaining washer *H* is held in place by a hexagonal-head cap-screw, which is screwed into the end of the locating plug *B*. Sufficient clearance is allowed to permit the locating plug to slide freely in the elongated hole. The clamping vee *E* is held in place by two gibs *D*, each of which is secured by two screws and one dowel. The elongated hole in the clamping vee receives the cam *F*, which is a good working fit in the body *A* of the jig and is held in place by a retaining washer *J*, secured to the end of cam *F*. The cam-lever *C* is secured to cam *F* by means of pin *K*. When lever *C* is pressed down, it moves the clamping vee *E* up into contact with the boss on the work. Thus it will be seen that plug *B* keeps the work in a vertical position and that the vee in block *E* serves to locate the work horizontally. It will be evident from the illustration that the downward movement of lever *C* forces the work upward, so that it is held tightly against the

member of the fixture that contains the drill bushing.

The final machining operation on the fan bracket is sawing and straddle-milling the boss for the clamping bolt. The fixture used for this operation is shown in Fig. 3. It is designed to hold five pieces on an arbor, all five pieces being clamped with one key. The work is loaded on the arbor before it is placed in the fixture, and the clamping key put in place. It is necessary to have two arbors with this fixture, so that the operator can be loading one while the milling operation is being performed on the work mounted on the other. The arbor *B* is located in the cast-iron base *A* by means of square sections at each end. It is clamped in place by two hinged members *F*. The hinged members are pivoted on pins *J* at one end, and clamped down at the other end by eyebolts *E*, which, in turn, pivot on pins *H*.

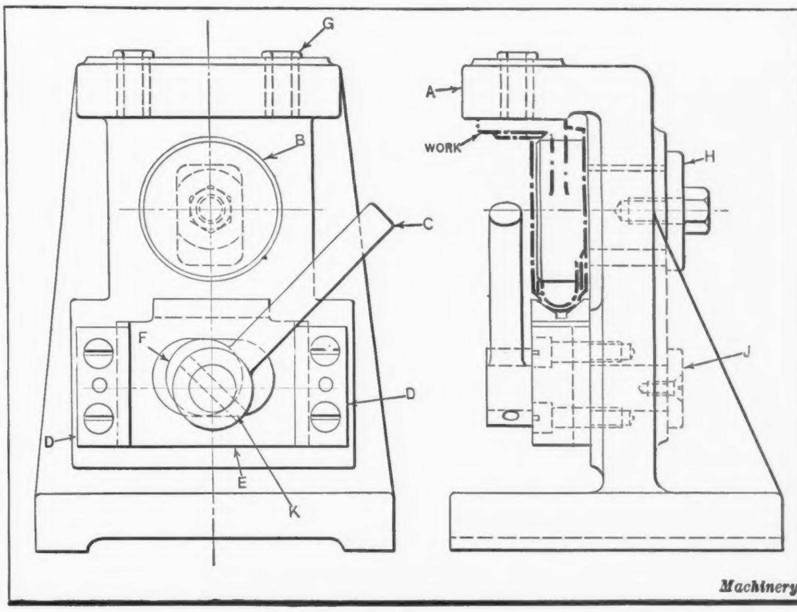


Fig. 2. Drill Jig used in drilling Holes in Base of Fan Bracket

The arbor *B* has two flat portions, one at the top and one at the bottom. The flat on the bottom serves to locate the spacers *C* in the correct position on the arbor, and the one on top is provided to give the cutter sufficient clearance. The work is held in place on the arbor by the clamping key *D*. Hardened strips *K* serve to square up the work when the arbor *B* is placed in the base *A*. After the arbor is dropped in place, with the work resting on the hardened strips *K*, the key *D* is driven inward, so that the work is clamped up against the flange or collar at the opposite end of the arbor. The hinged clamps are then tightened down. A hardened and ground plate *G* is provided for setting the cutters. The keys *L* serve to align the fixture on the milling machine table.

* * *

ANNUAL MEETING OF THE A. S. M. E.

The forty-fourth annual meeting of the American Society of Mechanical Engineers will be held in the Engineering Society's Building, 29 W. 39th St., New York City, December 3 to 6. At this meeting the Machine Shop Practice Division will consider the development of modern metal-stamping practice and will hear a progress report of the Research Committee on the present status of the art of cutting metals. The Management Division has a program on the relation of mechanical engineering to management in the metal-working, woodworking and textile industries. The Textile Session will discuss the organization and construction of woolen mills and the prevention of steam loss in finishing plants. At a joint session with the American Society of Refrigerating Engineers, heat transfer and insulation will be the topics. The Gas Power Division will have the solid-injection engine and the economic status of oil engines as its topics. The Power Division will have two sessions, one on methods of measuring water flow and another on heat cycles and boiler-plant economics. The Railroad Division is centering on the one subject of modern subway cars and their operation. The Fuels Division and the Materials Handling Division are cooperating in one session on the subject of coal storage in its engineering and economic phases.

The Wednesday evening session of the meeting will be devoted to the subject of hydro-electric power. John R. Freeman, past-president of the American Society of Civil Engineers and of the American Society of Mechanical Engineers, will outline the fundamental principles underlying the economic development of hydro-electric power. The American Society of Civil Engineers and the American Institute of Electrical Engineers will cooperate in the program.

In general it is planned to avoid conflict with the National Exposition of Power and Mechanical Engineering which will be held simultaneously with the annual meeting. By arranging sessions of interest to power engineers during the mornings of the meeting this conflict will be avoided as the Power Show does not open until noon each day.

* * *

The use of the electric arc-welding process in steel-building construction has not made very rapid progress, says the *Welding Engineer*, owing to a lack of confidence in the process on the part of architects and engineers. A few structures, however, ranging from small sheds to 40- by 100-foot buildings have been erected without a single rivet being used, all structural members being electrically welded. A 125-foot cross-channel barge and a 500-ton coastwise vessel were constructed in England and were completely arc-welded throughout. Undoubtedly there is a big future in the structural field for the arc-welding process.

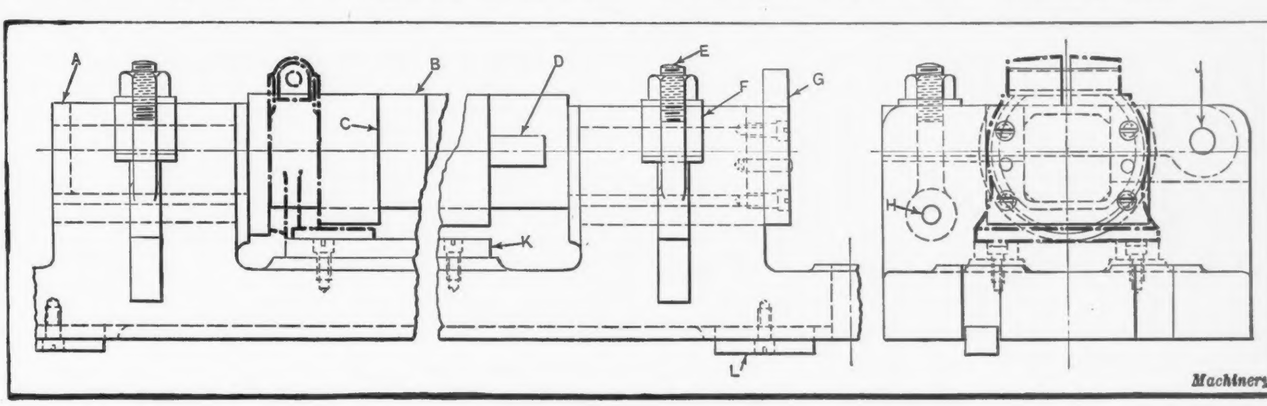


Fig. 3. Fixture used for slotting and milling Sides of Fan Bracket Boss

Scheduling and Progress-Recording of Drawings

By IRWIN HOFFMAN, U. G. I. Contracting Co., Philadelphia, Pa.

Although great progress has been made in the development of production and planning methods, a standard system of scheduling or progress-recording of drawings is to be found in but few of our large drafting-rooms. The reason for this is that the requirements for scheduling systems vary so greatly in different drafting-rooms that one system could not be satisfactorily applied to all. However, a system followed out and developed by the writer which has proved successful in the drafting-rooms of a large contracting company is described in this article, with the hope that it may be of service to other companies having similar requirements.

The work of the company where the writer is employed and where the system to be described has been in use for over a year, includes the design, furnishing, and erection of coal and water gas apparatus and steam and hydro-electric plants. In addition, a general construction business is also conducted. Over 150 draftsmen doing varied classes of work are employed in the drafting-rooms. The need for an efficient scheduling and progress-recording system in this plant is great, as the engineers must keep in close touch with the progress of the work in the drafting-room. The object of the system is to provide a basis for scheduling the work of listing and ordering material.

The completion of a job on schedule time requires the careful and proper management of the following work: (1) Completion of drawings; (2) listing of material; (3) ordering of material; (4) production in shops; and (5) erection in the field. Allowing a certain amount of time for each step, a complete schedule may be arranged. The scheduling and progress-recording system that is the subject of this article concerns itself only with the first two factors, namely completion of drawings and listing of material.

The system is based on the graphical chart shown in Fig. 1. Space is allowed for a span of four months, and each month is divided into thirty-one divisions corresponding to days. The work done on any of these days is recorded in the division opposite the proper drawing title. A heavy black dash shown in any space indicates drawing work on that day; a red dash (indicated in the illustration by wavy lines as shown under the dates April 2 and 3 on the line "General Arrangement") indicates checking work; and the small check-marked circle indicates the completion date. The long dotted line shows the time interval in which the drawing should be made and checked. This "schedule line" starts at the estimated starting date and ends on the estimated completion date. The extremities of the line are emphasized by heavy black dots.

Often the drawing cannot be completed within the time limit set; owing to various causes, some of which will be explained in detail. In that case a new completion date is obtained and the estimate line extended, terminating in another heavy dot. Thus several heavy dots often appear in the estimate line, showing where the schedule was extended.

Application of Progress-recording Chart

To illustrate how the information is obtained and recorded, we will consider a typical work order, and study the progress-record and schedule of several drawings, noting the causes for delays and the various factors affecting the progress. Work Order 2089 is a blue gas plant for Rio de Janeiro, Brazil. The list of drawing titles has been obtained from the chief draftsman, who also furnished the estimated starting and finishing dates of each drawing as given in Fig. 1. The "General Arrangement" was originally estimated to begin on March 6 and finish March 17. Drawing work was done on March 7, 10, 12, and 13. As the work progressed, the data on hand were found to be insufficient, necessitating a delay while information was being obtained from the customer.

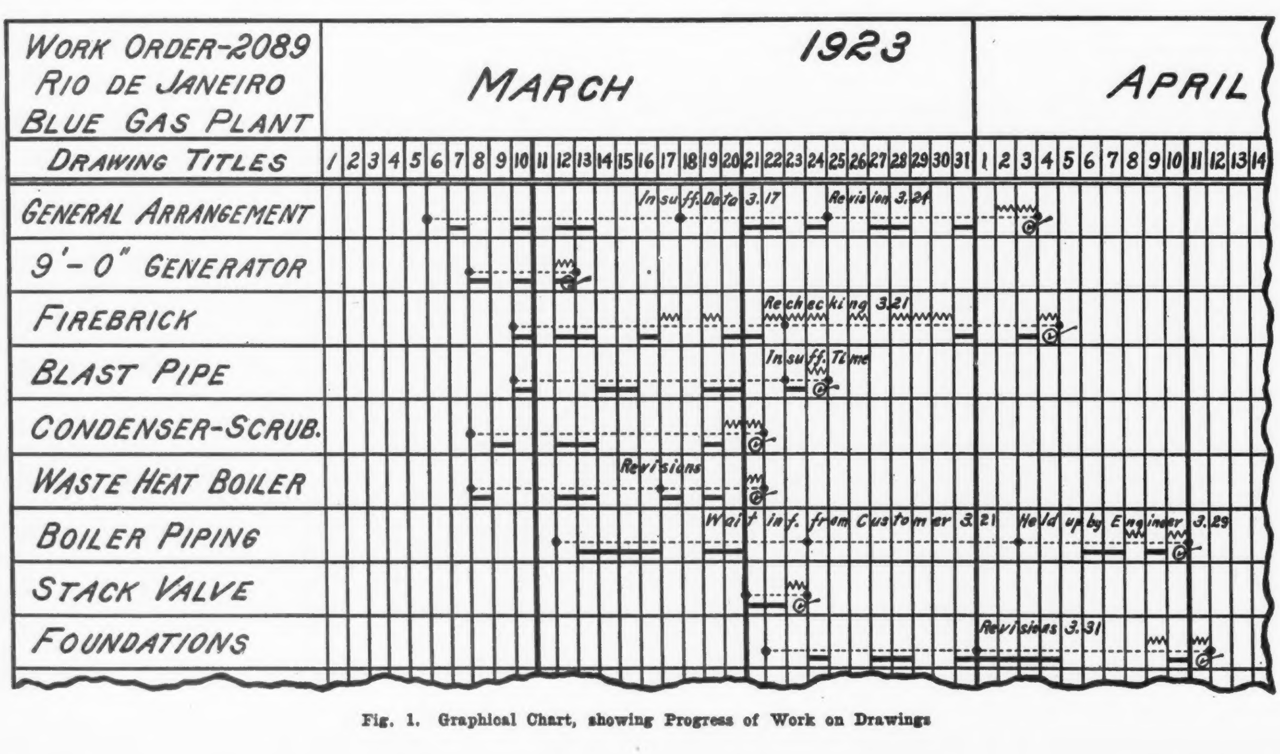


Fig. 1. Graphical Chart, showing Progress of Work on Drawings

Inquiry of the chief draftsman at this time brought out the fact that the drawing could not be finished before March 24. The estimate line was thereupon extended to that date. The necessary information was received and work was started again on March 21, as indicated by the heavy black line, but it was learned that revisions, occasioned by changes in design developing from the additional information, would necessitate a further delay until April 3. As recorded in the illustration, the drawing and checking work was finally completed on that date.

The next drawing recorded is that of a 9-foot generator. The schedule covers five days, from March 8 to 12. Drawing work was done on March 8, 10, and 12, and the checking was done on March 12. The check-marked circle shows that the drawing was completed on March 12. A little further down the list is "Boiler Piping." The original time estimate was from March 12 to 23. But on the 20th, work was suspended, waiting further information from the customer, and on the assumed basis that it would arrive about the 29th, the schedule was extended to April 2. However, when the information was received on the 29th, the designing engineer held up further work to determine whether any changes might be involved. This necessitated changing the schedule to April 10, and, as will be seen, the drawing was completed on that date.

Form H-177 1M 8-16-23

DRAFTING SCHEDULE
REPORT NO. 3

SHEET NO. 1
DATE March 21, 1923

ON DRAWINGS LISTED BELOW, DRAWING WORK WAS FINISHED ON DATE SHOWN:

W. O. NO.	LOCATION	DRAWING TITLE	COMPLETION DATE	ESTIMATED LISTING DATE
2089	Rio Janeiro	Condenser - Scrubber	3.21	
"	" "	Waste Heat Boiler	3.21	

Fig. 2. Daily Report containing List of All Drawings completed during the Day

It will be noted that all delays and changes in schedule are explained on the chart by abbreviated notes written in above the recording lines. With a complete record of all drawings shown in this manner, the schedule and progress-record becomes a very simple thing to follow and understand, and any question on the progress of the work can be easily answered.

Form H-176 1M 8-16-23

DRAFTING SCHEDULE
REPORT NO. 2

SHEET NO. 2
DATE March 21, 1923

THE FOLLOWING CHANGES WERE THIS DATE MADE IN DRAFTING SCHEDULES:

W. O. NO.	LOCATION	DRAWING TITLE	PREVIOUS SCHEDULE		REVISED SCHEDULE		ESTIMATE LISTING DATE
			STARTING DATE	COMPLETION DATE	STARTING DATE	COMPLETION DATE	
					Rechecking		
2089	Rio Janeiro	Firebrick	3.10	3.22	✓	4.4	
				Insuff. time allowed			
"	" "	Blast Pipe	3.10	3.22	✓	3.24	
			Wait inf. from customer				
"	" "	Boiler Piping	3.12	3.23	✓	4.2	

Fig. 3. Report showing List of All Delays and Changes on Drawings during the Day

The daily time vouchers of the draftsmen show what drawing work was done during the day. These vouchers are collected each day and handed to the schedule man who enters on the chart all drawing and checking work shown. When a schedule nears completion, the schedule man inquires of the chief draftsman whether the schedule will hold good. The chief draftsman gives the necessary information; that is, he tells whether the drawing will be delayed or finished on time, and the results are entered as has been described.

The next step in the system is the making up of daily reports at the close of each day. Three standard forms are shown in Figs. 2, 3, and 4. The form shown in Fig. 2 contains a list of all drawings completed during the day; that in Fig. 3 contains a list of all delays and changes in the drawing schedules; and the form in Fig. 4 contains a list of all new drawing schedules added during the day. By comparing these reports with the chart, it will be noted that they contain a summary of all changes and developments occurring on March 21.

The extreme right-hand column on these report sheets is reserved for the estimated listing dates. These dates are entered by the man in charge of the listing of material. When this is done, the reports go to the engineers' office, where the results are tabulated and a record kept of the progress of the work orders, with special reference to ascertaining dates on which material will be listed for ordering. In this way the main office is kept in contact with the daily progress in the drafting-rooms, making it possible to forecast the probable ordering and production of material. Thus it is possible to correlate the production of the various items, so the erection can proceed smoothly.

Such a system, based on graphical forms, depicts clearly and simply the entire drawing situation. One man can easily handle the progress-recording and scheduling work in an organization of the kind and size here considered. In smaller establishments this system might easily be combined with the time-keeping department.

* * *

Form H-175 1M 8-16-23

DRAFTING SCHEDULE
REPORT NO. 1

SHEET NO. 3
DATE March 21, 1923

ON WORK ORDERS SHOWN BELOW, SCHEDULES OF DRAWING WORK WERE THIS DATE PREPARED AS FOLLOWS:

W. O. NO.	LOCATION	DRAWING TITLE	STARTING DATE E-ESTIMATED A-ACTUAL	ESTIMATED DATE OF COMPLETION	ESTIMATED LISTING DATE
2089	Rio Janeiro	Foundations	E-3.22	3.31	
"	" "	Stack Valve	A-3.21	3.23	

Fig. 4. List of All New Drawing Schedules added during the Day

A new development in automobile tires is mentioned by the *India Rubber World*. A Reo car was recently equipped with 7½-inch truck tires inflated to only 18 pounds. These large but slightly inflated tires have a remarkable effect on the riding qualities of the car. Road surface irregularities are toned down and in most cases are obliterated. The hope is to take advantage of the reliable cord construction, combine this with a large section and thinner wall, and make it possible to ride on low-pressure air for the protection of the car and comfort of the passengers. The goal is to employ such tire constructions that the tire durability may not be impaired and to increase the area of contact so that air pressures ranging from 20 to 35 pounds can be employed in practice. The only disadvantage of these tires is that more power will be required to drive the car.

POLISHING REFLECTOR BOWLS

Manufacturing costs have been materially reduced during the last few years in the shops of the Edison Electric Appliance Co., Inc., Chicago, Ill., by the use of new methods of handling the miscellaneous line of products made, and by the installation of new machines that are more efficient than those formerly used. The new equipment, special or standard as required, is arranged with special mechanisms or fixtures. One of the interesting special machines is the semi-automatic machine illustrated in Fig. 1, which was developed for polishing the reflector bowl of "Hed-lite" heaters. This is accomplished at a considerably lower average cost than by the old method. The machine consists essentially of a double wheel-stand and two work-holding units, each of which swivels to feed the inside of a bowl over the periphery of a muslin polishing wheel on the stand. Only one oscillation is required to polish a bowl to the desired degree, and while the work in one unit is being polished, the other unit is being loaded with work. The production of this machine averages at least double that obtained by hand operation.

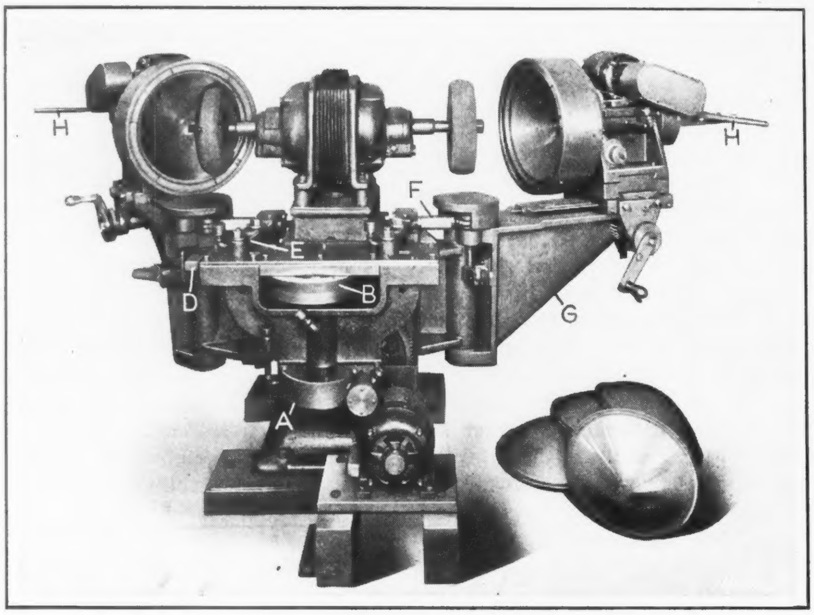


Fig. 1. Special Semi-automatic Machine for polishing Reflector Bowls

These reflector bowls are 14 inches in over-all diameter, approximately 4 inches deep, and made from 0.032 inch strip steel. The inside is a parabolic curve, and is given a bright copper finish. The muslin wheels are 12 inches in diameter and 3½ inches in width. They are mounted directly on the armature shaft of a 5-horsepower motor running at 1800 revolutions per minute. Power for driving the oscillating mechanism is delivered by the motor at the base, which is of ½ horsepower capacity. On the armature shaft of this motor there is a spur pinion which drives a gear on a horizontal worm-shaft. The worm meshes with a worm-gear in housing *A*, which is mounted on a vertical shaft at the top of which cam *B* is attached.

Roller *C*, Fig. 2, engages with cam *B*, and as the roller is held to bar *D*, it oscillates the bar to the right and to the left as the cam revolves. One end of each link *E* is fastened to bar *D* and the other end to link *F*. Hence when link *E* is swiveled on its pivot due to the movement of bar *D*, its particular work bracket *G* is swiveled on a vertical bearing through link *F*. Each work-holding unit is swung back and forth across the buffiing wheel at each revolution of cam *B*, which revolves at a speed of three revolutions per minute.

The work-holding chucks are of the sectional type, with six segments which are clamped on the periphery of the work to hold it in place for the operation. These segments are operated through lever *H*, which actuates fingers that control the movement of the chuck sections. The chucks are driven by individual ¼-horsepower motors running at 1800 revolutions per minute. The drive from these motors to the chucks is through spur and worm reduction gearing that brings the speed of the chuck to 45 revolutions per minute. It will be seen that there are both horizontal and longitudinal adjustments of the chucks relative to the swiveling brackets, and hence the chucks can be so positioned on the brackets as to insure the desired pressure of the bowls against the wheels. A mechanism carried on each of the swiveling brackets provides means for disengaging the drive to the bracket; the disengagement is accomplished by lowering the pin that connects link *F* to the bracket.

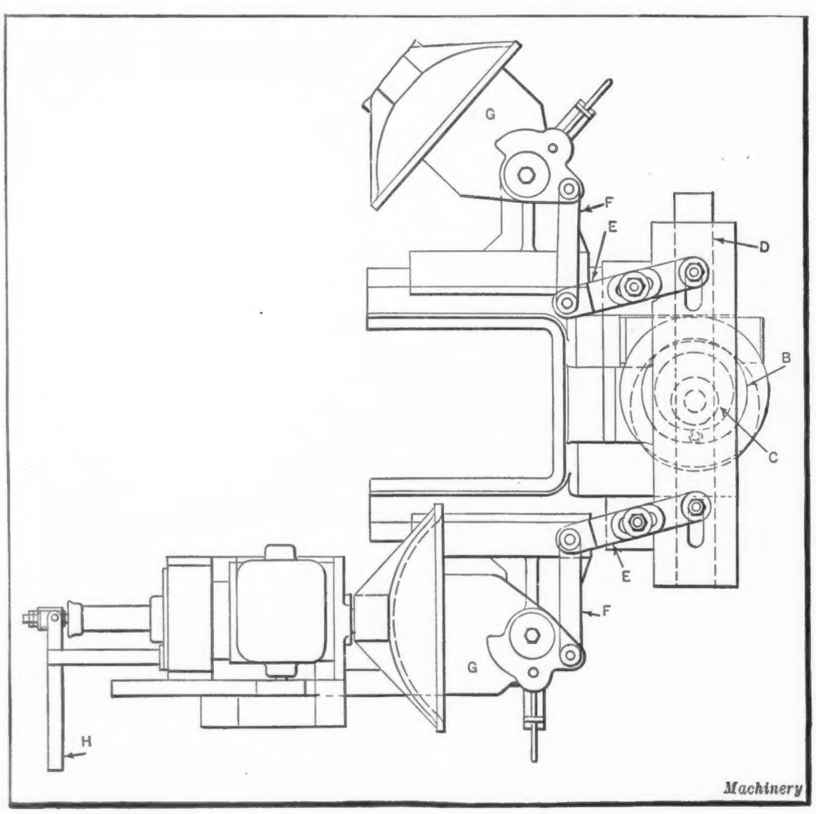
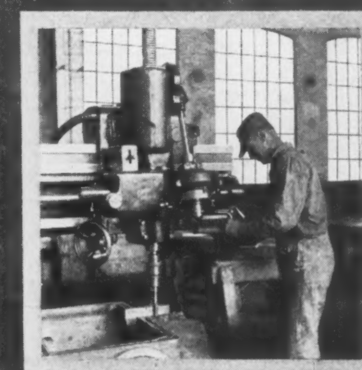


Fig. 2. Diagram of the Mechanism for swiveling the Work-holding Units

* * *

The possibilities in the simplification of automobile design are well illustrated by the reference recently made by an automobile designer to the efforts to reduce the number of parts in automobile engines. It was stated that the engine of a well-known automobile contains 2300 parts, while that of a newer design in the field, with the same number of cylinders and, in general, the same type of engine, contains but 832 parts. Such simplification is of the greatest value, and indicates that there are still possibilities for advance in automobile engine design.

Letters on Practical Subjects



DIES FOR BLANKING AND FORMING HANDLE

The can handle shown at *A*, Fig. 2, is made in two operations. The blanking die on which the first operation is performed is of the usual type, except that the punch has its cutting edge beveled. The bevel on the punch starts a curl in the edges of the blank, which is finished in the second operation. A stacking chute is provided for this die, consisting of six rods screwed into the bottom of the die and a plate which slides on the rods. A rubber friction pad fitting tightly on the rods backs up the plate.

The blanking die with the stacking chute attached is shown in the upper right-hand corner of Fig. 1. When the blanking die is started, plate *P* and pad *Q* are pushed up into contact with the die so that the blanks will have no opportunity to turn over. As the blanks accumulate, the punch forces the pad down. When the chute is nearly full, the blanks, one of which is shown at *B*, Fig. 2, are removed by the man in charge of the forming press. A spring-actuated pin *R* prevents the blanks from adhering to the punch.

The second operation—forming and curling the handle—is performed on the die shown in the two elevation views in the lower part of Fig. 1 and in the plan view in the upper left-hand corner. The cast-iron die-shoe is provided with a machine-steel slide *B* at one end and a tool-steel curling plate *C* at the other. On slide *B* there is a forming plate *D*, which is supported by five springs *E*, its travel being controlled by shoulders on screws *F*. The other forming plate *G* is held in a similar manner. The punch *K* is made from

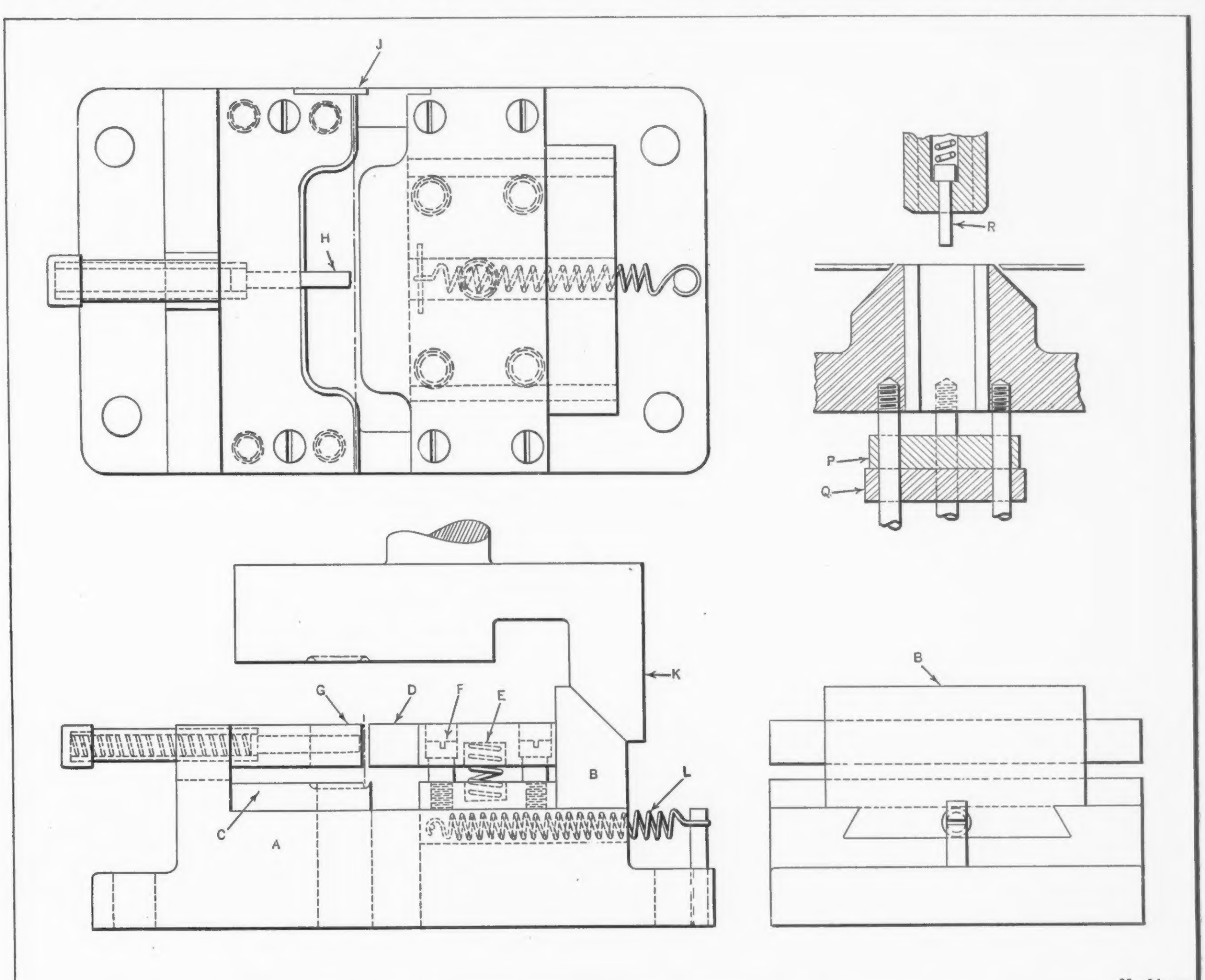


Fig. 1. Dies employed for blanking, forming and curling a Can Handle

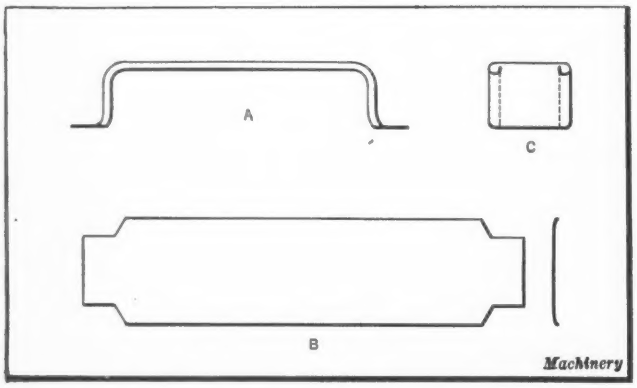


Fig. 2. (A) Sheet-metal Handle formed on Press Dies; (B) Blank as it appears before being formed

a one-piece machine-steel forging, and has the curling groove and camming surface casehardened. A spring-actuated pin *H* keeps the blank from shifting while being formed and acts as an ejector. A spring *L* keeps the slide back in the position shown, except when the punch is in the downward position.

The operation of forming the handle is as follows: The operator takes a stack of blanks from the first-operation press and lays them on their sides on a table located close to the die. The blanks are fed into the die jaws with a rubber-tipped stick until they come into contact with the stop *J*. The press is then tripped. When the punch descends, it forces the jaw *D* to move to the left, so that the blank is formed to the required shape. Further downward movement of the press causes the springs *E* to be compressed so that the grooves in the punch and in the lower curling plate will curl the sides of the handle, as indicated by the view at *C*, Fig. 2. As the punch ascends, the slide carries the moving jaw *D* back to the right, and the spring-pin *H* ejects the finished handle, so that it falls through an opening in the bottom of the die into a chute which guides it to the work-box beyond the press. When the blanking and forming press are operated at the same time, it is advisable to keep a reserve stock of blanks on hand for the second operation so that any temporary slowing down of the blanking press will not necessitate the shutting down of the forming press.

Brooklyn, N. Y. S. A. McDonald

SAVING SCREW MACHINE STOCK

A method of saving screw machine stock, which consists of utilizing the core from a hollow-turned piece to make a second and smaller piece, instead of drilling out the center core, is described in this article. The method is limited to combinations in which one of the parts is comparatively large and thin walled and the other part small in diameter. The combined machining operations required must, of course, be within the turret capacity of the screw machine. The operations described in the following were performed on a Brown & Sharpe automatic screw machine having a six-hole turret and two cross-slides. The pieces produced are shown by the two views at the left of Fig. 1. The diagrammatic view at the right-hand side of this illustration will serve to make clear the manner in which these two pieces are produced from the same piece of stock.

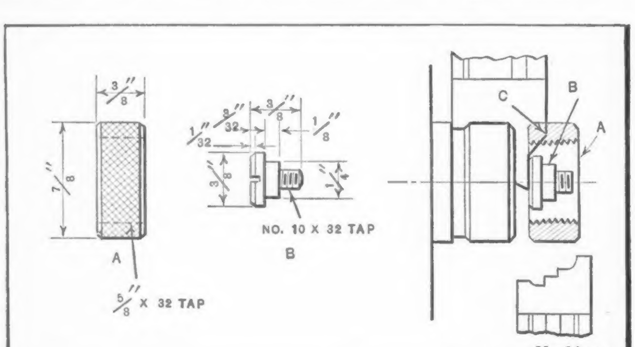


Fig. 1. Details of Two Screw Machine Products and Diagram illustrating Methods of making One Piece from the Core of Another

Fig. 2 gives a good idea of the general lay-out of the cams that control the movements of the tools employed in the production of the pieces. The production time for the ferrule, which is the part shown at the extreme left-hand side of Fig. 1, was 28 seconds when using the older method, and the production time for the screw approximately 15 seconds. With the new method the production time for the two parts *A* and *B*, Fig. 1, was 55 seconds. The net loss of 7 seconds in the production time, however, was largely offset by the time required in setting-up. Only one set-up is required by the new method and only one bar of stock has to be cared for. The stock between the ferrule *A* and the screw *B* was first removed by a trepanning tool. It will be noted that the back slide tool has an angular lobe or corner

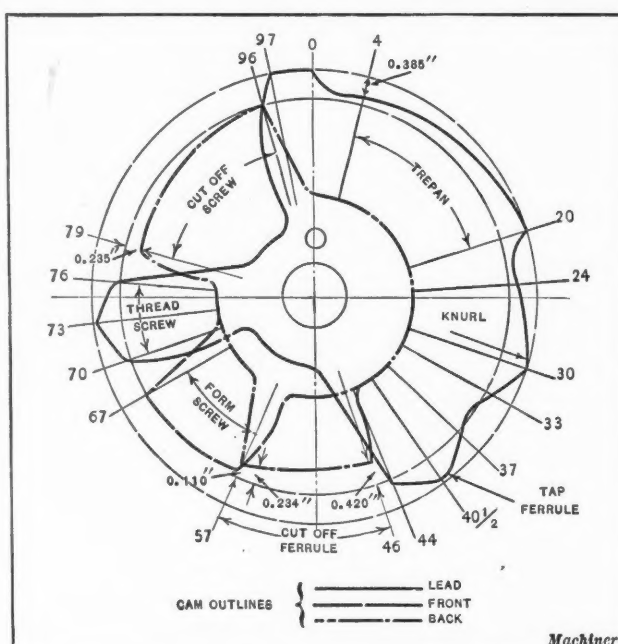


Fig. 2. Diagrammatic Lay-out of Cams used in the Production of the Pieces shown in Fig. 1

C which is shown in Fig. 1 superimposed upon the piece *A*. This lobe is so proportioned as to engage the corner of the ferrule immediately after it is parted from the stock. During the remaining travel of the tool there is a tendency to wedge the ferrule outward, thus preventing it from hanging to the screw and fowling the succeeding tools.

The order in which the operations are performed is given in the following: (1) Trepan—0.385-inch rise, at a feed of 0.002 inch and a speed of 1216 revolutions per minute; (2) revolve turret; (3) knurl on; (4) knurl off; (5) revolve turret and change speed to 530 revolutions per minute; (6) tap in; (7) tap out; (8) clear, reverse the spindle and change the spindle speed to 1216 revolutions per minute; (9) cut off ferrule—0.185-inch rise at a feed of 0.0015 inch per revolution; (10) form screw—0.110-inch rise at a feed of 0.001 inch per revolution; (11) clear and change speed to 530 revolutions per minute; (12) thread on; (13) thread off; (14) clear, reverse spindle and change speed to 1216 revolutions per minute; (15) cut off screw—0.235-inch rise at a feed of 0.0012 inch; (16) clear; (17) feed out stock.

Rochester, N. Y. Ernest C. Allen

WEIGHT REMOVED FROM SPHERE BY BORING

It is sometimes useful to know beforehand, when drilling or boring a hole in a sphere or ball, just how much weight of metal will be removed; or, when calibrating a spherical counterweight, just what diameter hole to bore to remove a given amount of weight. Separate calculations can be made in each case, of course, but a glance at Fig. 1 will give an idea of the difficulties encountered. A hole drilled through a sphere removes not only the cylindrical portion *ABCD*, but also the two spherical segments *AED* and *BFC*. A formula was worked out to cover all cases, but even this formula offers some difficulty in its application. The formula is

$$d = D \sin\left(\cos^{-1}\sqrt[3]{1 - m}\right)$$

where

d = diameter of hole;
D = diameter of sphere; and
m = per cent of weight removed.

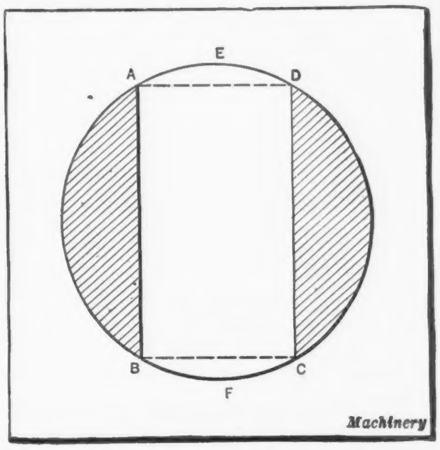


Fig. 1. Sphere with Hole drilled through Center

However, the formula shows that there is a simple direct relation between the diameter of the sphere and the diameter of the hole to be drilled in removing any given percentage of its weight. It was noted that a graph plotted from this formula for a sphere 1 inch in diameter, as shown in Fig. 2, would give results that could be applied to a sphere of any size by using the diameter of the sphere as a factor. The application will be clear from the examples:

Example 1—How much will the weight of a 4-inch cast-iron ball, weighing 8.75 pounds, be reduced by drilling a 1-inch hole through it?

The ratio of the diameter of the ball to that of the unit sphere of the graph is 4 to 1, and the diameter of the drilled hole must be reduced in the same ratio before the graph can be used. In this case we have $1 \div 4 = 0.25$. Following the 0.25 line of the left-hand scale horizontally until it crosses the curve and then reading downward to the percentage scale, we get the value 0.09, or 9 per cent.

As the percentage of weight removed from a 1-inch sphere by a 1/4-inch hole is the same as that removed from a 4-inch ball by a 1-inch hole, the value 9 per cent can be applied directly to the given ball. Thus the weight removed equals $8.75 \times 0.09 = 0.79$ pound.

Example 2—A cast-iron ball 4 1/2 inches in diameter, weighing 12 1/2 pounds, is to be reduced to exactly 9 pounds weight. What diameter hole must be bored through it to accomplish this result?

The amount of weight to be removed is $12.50 - 9 = 3.50$ pounds. The percentage of the weight of the ball that is to

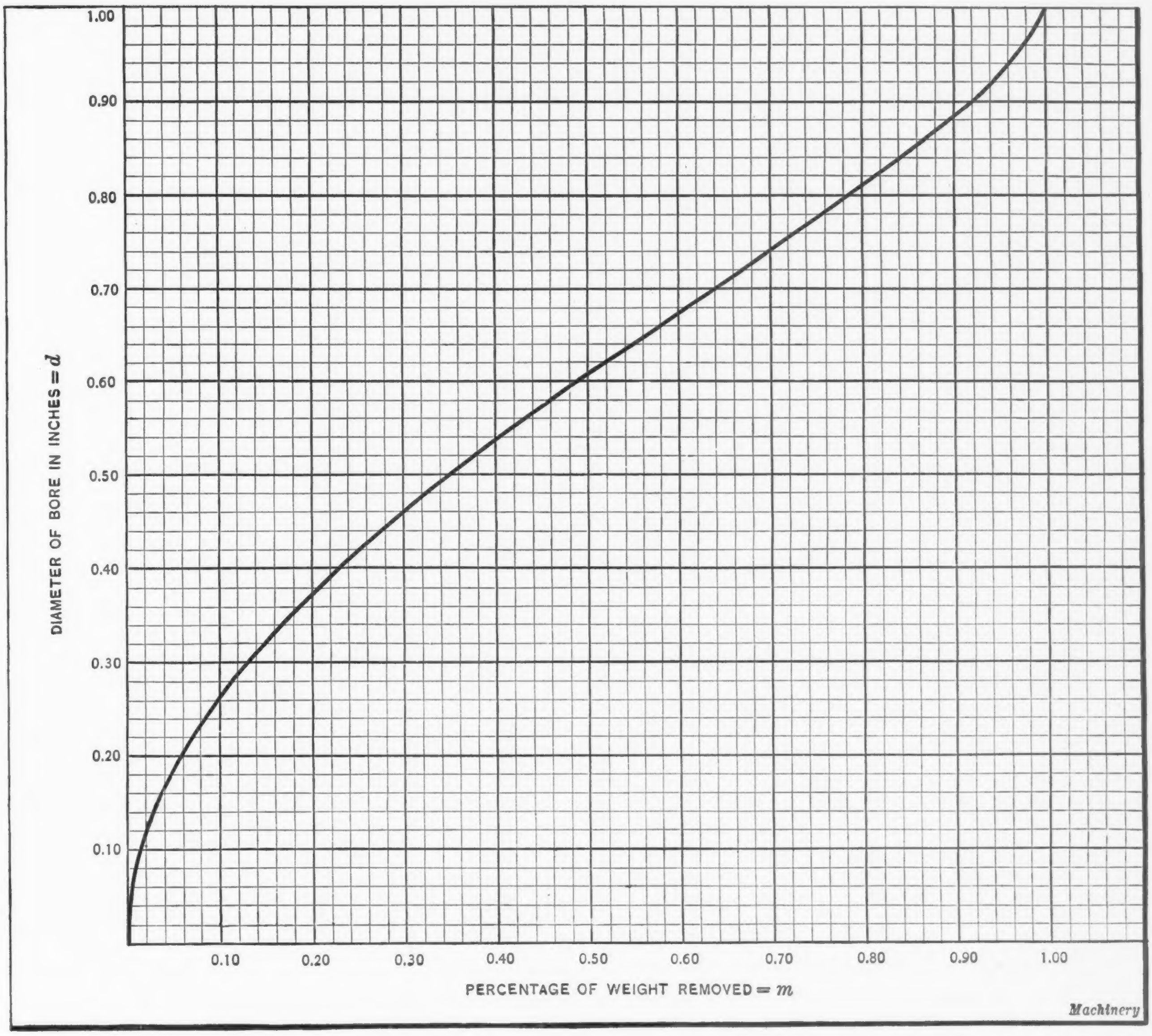


Fig. 2. Chart showing Per Cent of Weight removed by drilling Holes through a Sphere One Inch in Diameter

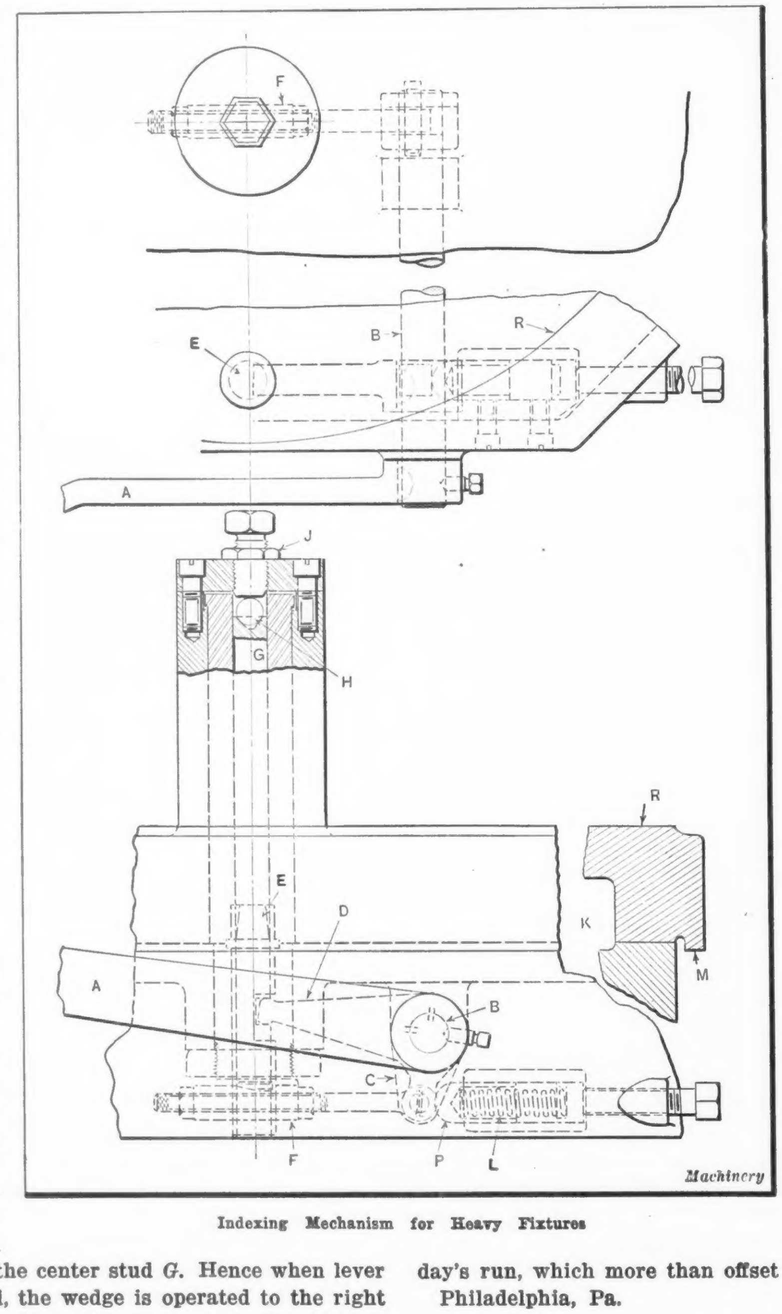
be removed is 3.50 ÷ 12.50 = 0.28. From the graph, the reading on the left-hand scale corresponding to 0.28 on the bottom scale is 0.44. This would be the diameter of the drill to use in removing the desired percentage of weight from a 1-inch sphere, but before applying it to the 4½-inch sphere it must be multiplied by 4½, thus we have 0.44 × 4.5 = 1.98 inches which is the required diameter.

FRANCIS M. WESTON, JR.
U. S. Naval Air Station, Pensacola, Fla.

INDEXING DEVICE FOR HEAVY FIXTURES

Difficulty is often experienced in operating heavy indexing fixtures because of the large amount of friction developed between the sliding surfaces. A device that insures easy rotation and is applicable to fixtures of almost any size is shown in the accompanying illustration. Accurate indexing of work is obtained by a pin *E* which successively engages bushings spaced around the rotary member *R* to suit the desired indexing.

Pin *E* is operated in and out of the bushings by means of arm *D*, the pin being withdrawn when lever *A* is lowered, and inserted when a bushing is brought into position above the pin and pressure on the lever is released so that coil spring *L* is free to act. Simultaneous movement of lever *A* and arm *D* is effected by mounting the two on shaft *B*. The arm has a small extension at right angles to it, against which coil spring *L* exerts pressure through plunger *P*.



Indexing Mechanism for Heavy Fixtures

Easy rotation of member *R* is arranged for by a device in the center of the fixture, which is also operated by shaft *B*. Part *F*, which has a wedge-shaped surface on the upper side, is connected to shaft *B* by a long bolt and link *C*. The wedge *F* is round and operates in a reamed hole through the center stud *G*. Hence when lever *A* is lowered and raised, the wedge is operated to the right and left, respectively. As the wedge is moved to the right, it forces the center rod *G* upward and pushes ball *H* against plug *J*. This raises the rotary member *R* sufficiently from the base casting to permit easy movement of the rotary fixture about its center, with the weight resting on ball *H*, rod *G*, wedge *F*, and the base casting. It will be apparent that the rotary fixture is raised this slight amount at the same time that the index-pin *E* is withdrawn from a bushing.

Both wedge *F* and stud *J* are adjustable to provide for lifting part *R* just the required amount to permit easy indexing and to compensate for wear. The fixture for which this indexing device was designed was about 30 inches in over-all diameter and was supplied with a ⅞-inch ball *H*. A ledge *M* was cast on the rotary member to prevent dirt and chips from getting between its sliding surface and that of the base.

Cleveland, Ohio HERBERT W. CABLE

LOCATING STOCK BY PILOT HOLES IN CUT-OFF CHIP

At the shop where the writer is employed, a hand-fed die had been in use for some time in the production of small metal parts. This die had an average daily production of about thirteen thousand parts. Having been instructed to design another die for this work, the writer decided to attempt to operate the new die in an automatic press in order to increase production. The piece of work required two piercing operations, one forming and one cut-off operation, but the piercings were so small that a pilot could not be used with any degree of accuracy, and to locate the work automatically against a stop was considered impractical. The method described in the following was finally employed with satisfactory results.

The width of the cut-off punch was doubled, so that ¼-inch instead of ⅛ inch was wasted in the cut-off chip. Another piercing operation was then added, a round hole, slightly smaller in diameter than the width of the chip, being produced in the space allotted to the chip. Next, a pilot was added to locate the work from this hole. This pilot hole was afterward cut out by the cut-off punch. Though this method slightly increased the amount of waste, it increased production greatly, sixty-five thousand being an average day's run, which more than offset the small waste of stock.

Philadelphia, Pa. R. H. KASPER

* * *

At a recent meeting of the Vermont Society of Engineers, held at Windsor, Vt., a petition was signed and forwarded to the Council of the American Society of Mechanical Engineers, requesting that a local section of the A. S. M. E. be founded to cover the state of Vermont, and to be known as the Green Mountain Section. This local section of the American Society of Mechanical Engineers will be affiliated with the Vermont Society of Engineers.

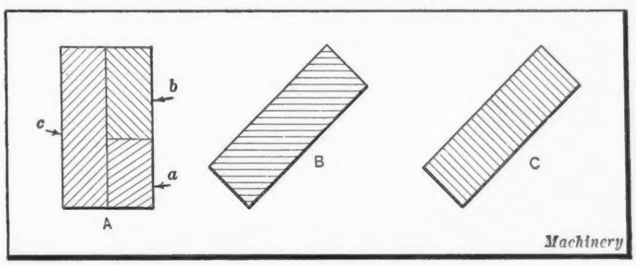
Questions and Answers

CROSS-SECTIONING OF DRAWINGS

A. L. R.—Should drawings be cross-sectioned only by lines running at 45 degrees, or is it permissible to cross-section also with 30- and 60-degree lines, in order to separate the cross-sectioned parts more clearly at a glance?

ANSWERED BY R. KRAUS, WOODLAWN, PA.

It is the custom in nearly every drafting-room to incline the cross-section lines at an angle of 45 degrees. Practically the only exception to this practice is illustrated by the accompanying diagrams. When more than two parts appear adjacent in one section view, as shown at *A*, two of the parts, such as *c* and *b*, may be cross-sectioned with lines



Methods of Cross-sectioning

inclined at an angle of 45 degrees, while the third part shown at *a* may be more readily distinguished from the others by inclining the lines at an angle of 30 degrees.

When a part is located at an angle of 45 degrees, as shown at *B* and *C*, horizontal cross-section lines should be used, as shown at *B*. If lines are drawn at an angle of 45 degrees, as shown at *C*, the part may appear more like a gear or notched piece than a cross-sectional view of a solid piece. For this reason the method of cross-sectioning shown at *C* should not be used. In general, it may be considered good practice to avoid making cross-section lines parallel to any of the sides of the part being sectioned.

ANSWERED BY HYMAN LEVINE, DENVER, COLO.

The object of cross-sectioning a drawing is to make clear the relation of different parts, and, when possible, the materials from which they are made. The lines employed are used for this fundamental purpose only, and the draftsman must use his judgment in determining how best to apply the general rules and how to modify them if necessary.

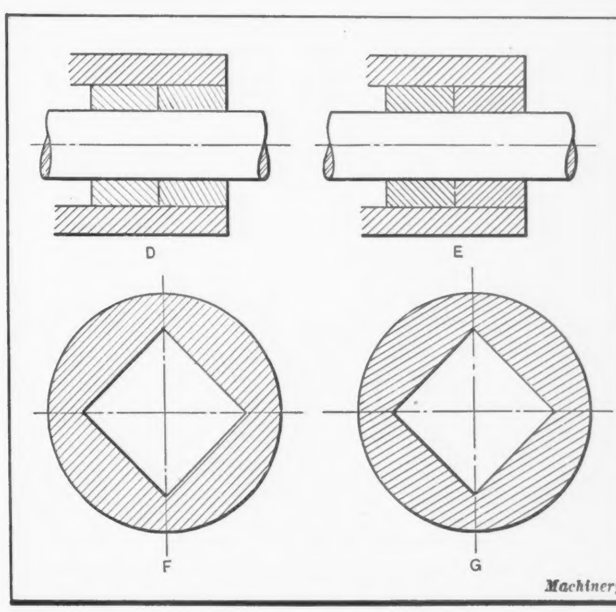
Lines of 45 degrees are used mainly because it is most convenient to use the 45-degree triangle. Furthermore, the 45-degree triangle does not need to be turned over when reversing the direction of the section lines. Adjacent sections appear more symmetrical with 45-degree section lines than with those drawn at other angles. Cases occur, however, where the exclusive use of 45-degree lines would make a drawing difficult to read. When there are three pieces adjacent to each other, the drawing may be made clearer by using, perhaps, 30-degree lines for two pieces, and 45-degree lines for the third, or *vice versa*. The sections of very small pieces on a drawing can sometimes be shown more clearly by inking them in a solid black, because they may be too small for effective cross-sectioning. Thus it will be observed that the correct method for cross-sectioning depends both upon the position of the pieces shown in the sections and upon their size.

For preliminary drawings, intended merely for the working up of designs, different methods for showing sections are employed. In one drafting-room it is customary to section all original designs by means of colored crayons, and this saves a great deal of time. The drawing shows in the clearest possible manner the relation between the different parts, the sizes of the sections, and the likelihood of interferences. The original lay-out is then discussed and necessary or desirable changes suggested, and after the final design has been definitely approved, the section lines are drawn with ink.

ANSWERED BY JOHN HOMEWOOD, ONTARIO, CAL.

Cross-section lines on a drawing are secondary in nature to the lines of the drawing itself, and usually show at a glance the kind of materials and the different parts. It is customary to make the cross-section lines at an angle of 45 degrees, having the lines of the adjacent parts at right angles. When the drawing is such that two of the parts that are in contact would have the section lines running parallel, thereby making the line of separation indistinct, the lines may be drawn at an angle of 60 or 30 degrees.

The cross-sectioning in the view at *D* shows at a glance that there are three parts, whereas that in the view at *E* is not so clear. Another governing feature is the shape of the part to be cross-sectioned. In sectioning a square part, where the vertical and horizontal center lines go through the diagonals of the square, the 45-degree section lines would be objectionable, and the 30- or 60-degree lines would be resorted to. A good rule is to make cross-section lines at an angle of 45 degrees except when the shape of the part is such that the lines would be parallel or perpendicular to any major line on the drawing. A glance at the sketch



Cross-sectioned Parts

of the square referred to as shown at *F* shows the objectionable method, whereas the view at *G* shows the correct method.

* * *

On account of the difficulties frequently encountered because catalogues and other trade literature are subject to tariff duty in foreign countries, the Department of Commerce, Washington, D. C., has recently published two trade information bulletins No. 122, "Shipment of Samples and Advertising Matter to the British Empire," and No. 145, "Shipment of Samples and Advertising Matter to Europe." These bulletins contain information in regard to the extra duties to which catalogues, advertising matter, and samples are subject in different countries.

The Machine-building Industries

THERE is much truth in the statement made by the Federal Reserve Bank of Cleveland: "We are altogether too much inclined to use boom periods as yardsticks." Production in many of the industries is not being rushed as it was last spring, but good business does not necessarily have to be a boom business. Considering the industries of the nation as a whole, there is no occasion for serious apprehension as to the future. Practically all the basic industries are well employed, although the iron and steel industry is working below normal because of the extreme activity in the early part of the year when production exceeded demand and considerable stocks were accumulated.

The general business situation may be briefly summarized as follows: Production is less active than earlier in the year, but is still large in volume and supported by a high purchasing power on the part of the great majority of the people, most of whom are employed, and—what is more—at wages that, on the average, are higher in proportion to the cost of living than at any previous period in the history of American industry. The slowing down of production is explained by the fact that neither manufacturers nor dealers show any disposition to accumulate a large amount of stock. No one wants to have machinery or goods on hand that he is not reasonably sure to sell within a comparatively short time.

The Machine Tool Industry

The machine tool industry is not as well employed as most of the other industries of the country. New orders are not being placed so freely as last spring, but October business, according to statistical records, was slightly better than September. Very few shops in the machine tool field are running a full force; those that do, are engaged in building special machinery for the automobile industry. Generally speaking, the busiest shops have about two-thirds of a full force at work, while the majority are employed at about one-half capacity; and several shops have not sufficient business on hand to keep even that percentage of a full force employed. Among the best selling standard tools are radial and sensitive drilling machines. There are few radial drills on the second-hand market, which accelerates business in this line.

The automobile industry is still the most important market for machine tools, but the demand is mainly for special machines for high production and automatic machines. In the standard lines of machine tools, the demand from this source is mainly for manufacturing lathes and high-duty drilling machines. The railroads are buying a limited number of machine tools, but the orders placed have been mainly for single machines rather than big lots.

The second-hand market in machine tools appears to be about normal. There have been a few auction sales of large dismantled plants at scattered points throughout the country, but on the whole, the supply of good second-hand machines is limited, and it is difficult to obtain used machines of the best makes.

The Small Tool Industry

In the small tool field, the demand was especially good early in the year—so good, in fact, that stocks were reduced to a very low level. At present, orders are not sufficient to keep the plants going at capacity, but several of the small-tool plants are still fully occupied replenishing their stocks, in addition to taking care of a substantial volume of new business. The electrical tool shops, while they have also experienced the falling off in orders that has affected the entire machine tool, small tool, and shop equipment field, are generally occupied to a greater extent than the machine tool shops. Some of the electrical tool manufacturers considerably reduced their stocks earlier in the year when business was very brisk, and are now employing the lull to replenish the supply in their stock-rooms. Some manufacturers of vises state that business continues on a satisfactory level, and in this field a fair export business to South Africa and India is reported.

The die-casting industry is in a satisfactory condition. Several of the die-casting plants are operating at capacity, and new applications are constantly being found for die-cast products. The transmission chain business is well employed. The demand for bicycle and motorcycle chain is especially good, although the motor truck chain business is somewhat less active at this time of the year.

The gear manufacturing shops are also well employed. The unusual activity in the automobile field during the past year has kept those devoted to automobile gears working at capacity. The shops engaged in the making of automobile replacement gears have also had a year of very active business, and the jobbing shops in the gear field have been fully occupied in most parts of the country.

Activity in the Automobile Field

The most remarkable feature of the industrial situation is the automobile production. Contrary to the experience of past years, production during the fall months has continued at an unusually high rate. In October, for example, according to the Department of Commerce, nearly 335,000 passenger cars and 30,000 trucks were manufactured. This is the highest for any month in any year preceding 1923. Furthermore, this year, every month from March to August, inclusive, reached 325,000. The total for the first ten months was 3,076,000 passenger cars and 318,700 trucks.

The Iron and Steel Industry

There was an over-production in pig iron in the earlier part of the year, and for that reason production is still slowing down. It is generally believed that the bottom of the pig iron market has not yet been reached. Present orders are not sufficient to absorb the stock accumulated for months past at the furnaces, nor have a sufficient number of furnaces been shut down to cause a material reduction in output. Since last May there has been a reduction of pig iron prices of nearly 30 per cent, with still further reductions in sight. Compared with a production of 100 per cent in 1913, the pig iron production in October this year was 123, and the steel ingot production, 141 per cent, both being higher than the production in October, 1922.

Summary of the Industrial Situation

It is generally conceded that economically and industrially we are, considering the nation as a whole, in a more favorable position than at any time since 1914. The industries have entered upon normal operation. There are neither the tendencies toward over-expansion and speculation that characterized the war years and the period immediately following the war, nor any evidence of the extreme inactivity of the depression that followed. The rapid recovery of American industry from the depression, and the rapidity with which general prosperity has been re-established, as evidenced by the prosperous condition in the transportation field and the automobile industry, is one of the most remarkable evidences of the healthy condition of the American business structure.

New Machinery and Tools

The Complete Monthly Record of New Metal-working Machinery

Gray Switch Planer

THE trend of railway construction is constantly toward heavier rails, and as railway switches are practically always made from open-hearth steel rails having a high carbon content, the problems of the switch-builder in maintaining production become more and more difficult as the work gets heavier. To meet the demands of modern requirements in switch-building shops, the G. A. Gray Co., Gest and Depot Sts., Cincinnati, Ohio, has brought out a planer of heavy weight and great power that is especially designed for this class of work. From Fig. 1 it will be seen that not only are the housings and rail of large proportions, but that the bed has been made deeper than usual so as to make it rigid where the gears are supported and where the heavy strain of cutting must be sustained.

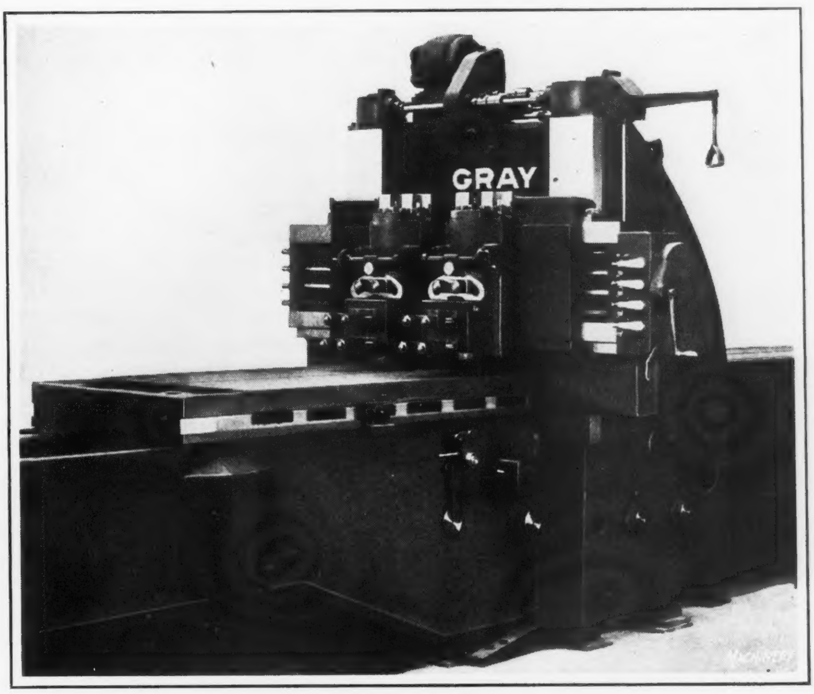


Fig. 1. Gray Planer designed for Heavy-duty Work in building Railroad Switches

Switch work is practically confined to two major operations consisting of feeding the two heads toward each other in order to take simultaneous cuts on the sides of two rails, and feeding the tools directly down into the flange of the rails, as illustrated in Fig. 2, to cut off the flanges. In the first operation mentioned, the operator depresses the highest and lowest clutch levers at the right-hand end of the rail, thereby throwing both the traverse and manual-feed levers on the end of the rail into engagement with the cross-feed screws. Then by turning the manual-feed crank, the desired amount of feed is easily obtained, both heads moving toward each other. When the cut has been completed, a single pull on the traverse lever, located directly underneath the manual-feed lever, starts the traverse motor and moves the heads quickly apart, ready for the next cut.

To change over to the second operation of flange cutting, the second and third levers at the end of the rail are depressed, and the others released by touching buttons provided for that purpose. Turning the manual-feed lever will then give a feed of both tools down toward the rail, while a single motion of the traverse lever brings both slides quickly back to the starting position. It will be noted that the change from one operation to the other is practically instantaneous without great effort on the part of the operator, who, with only two control levers to manipulate, can keep his eyes constantly on the tool and work. If desired, either head can be independently controlled.

The heads are of heavy and rigid design. On the lower

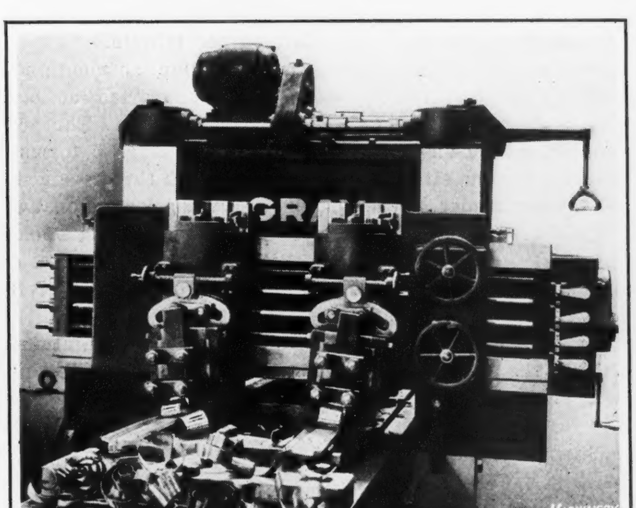


Fig. 2. Close-up View showing the Construction of the Heads and Rail

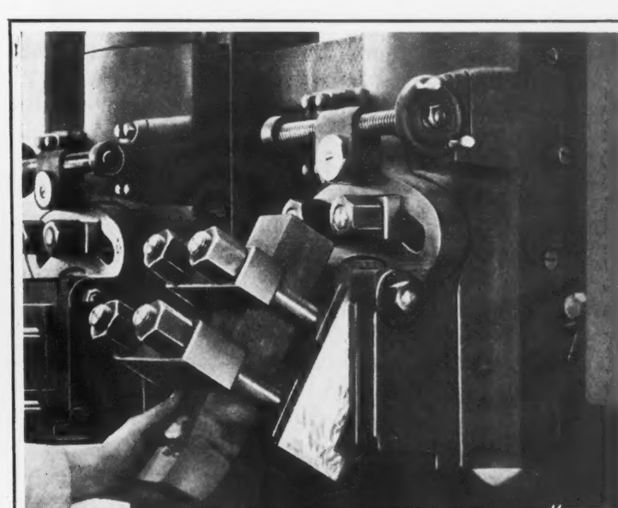


Fig. 3. View showing Shoulder on Apron that takes the Upward Thrust

end of the tool apron there is an abutment or shoulder, as shown in Fig. 3, which registers against a surface on the bottom of the tool-box to take the upward thrust of the cutting tool and thus relieve the pin on which the apron swings, from this pressure. A patent has been applied for on this construction. The patented twin-purpose taper gibs provided on other Gray planers of recent design are also supplied on this machine for the slides and heads. A turn of a handle in one direction adjusts the gib to the operating position, while a turn in the other direction locks together the two parts between which the gib is placed, throughout the length of the gib.

The Drive to the Table

Steel gears are used entirely in the drive to the table, and from Fig. 4 it will be noted that, from the drive-shaft pinions to the bull pinion, the gearing is of the balanced helical type. At the first reduction, for instance, a driven

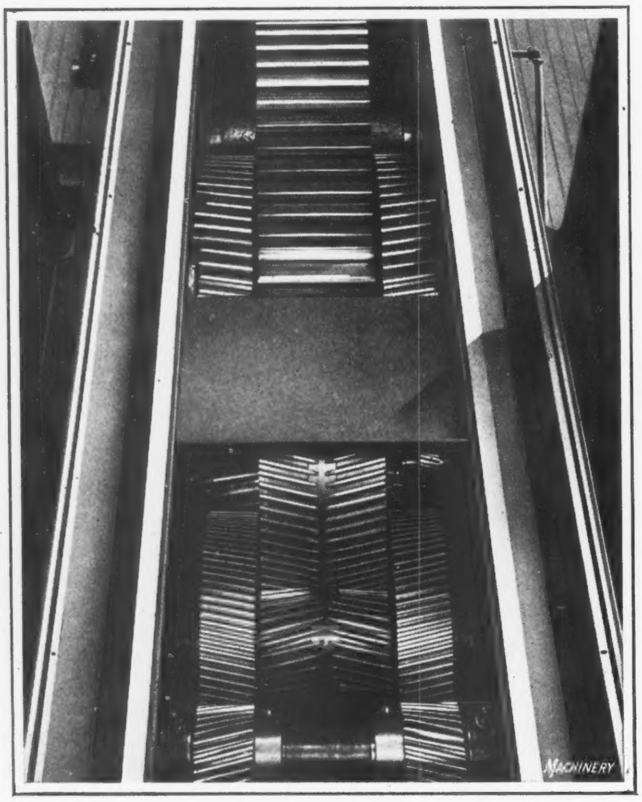


Fig. 4. View of the Balanced Helical Gear Drive to the Table

gear is mounted on each end of the pinion hub, thus balancing the torsional effect. Furthermore, the gears are keyed to the pinion hubs so that the torsional strain is transmitted through these large hubs instead of through the shafts. The shafts are pinned to the gears and rotate with them, being subjected only to shearing strain. The result is a rigid design that is said to eliminate vibration and chatter under the heaviest cuts. The gears run in a bath of oil.

Design of Bed and Provision for Lubrication

The bed is cast solid on the bottom to form an oil tank and at the same time to tie the walls together. The bed has four walls, two on each side of the gears, and each double wall is tied together by crosswise webs, so as adequately to support the bearings mounted in the walls and make the entire bed sufficiently stiff between the housings and throughout the gear space to absorb vibration. The bed is of double length, thus supporting the table throughout its entire travel.

Not only do the gears run in oil, but a flood of oil is also pumped to each bed vee and to the drive-shaft bearings. At each end of the bed a strainer plate and a settling basin are provided, and from the settling basin the oil returns to the central reservoir. From here it is passed through a second strainer and filtered before being returned to the vees and bearings. Both the pump and filter are mounted on the outside of the planer for ready inspection, and the oil-pump is coupled directly to the drive shaft. The lubrication of parts on the top brace is simplified by the use of centralized oilers such as are provided on the Gray "Maximum-Service" planer and by having the ball bearings of the motor run in grease, and the traverse gears driven by the motor enclosed and running in oil.

While the rail position is not often changed in switch-shop work, it may be readily raised or lowered by pulling down the stirrup at the right-hand end of the rail and then pushing the traverse lever into the running position. The rail is clamped on the outside and inside edges of both housings. In a test conducted on a planer of this design, the flanges of two 100-pound rails, of 70-point carbon, open-hearth steel, were cut through with five strokes of the planer. The width of the cut varied from 0 to 3 inches, the feed was about 1/8 inch, and the cutting speed, 25 feet per minute, although the range of cutting speeds available on the machine is from 25 to 50 feet per minute.

CINCINNATI INTERNAL-TRANSMISSION SHAPER

A new line of shapers, embodying a number of features original in shaper design, has just been brought out by the Cincinnati Shaper Co., Cincinnati, Ohio. The principal features of these shapers are as follows: The speed and driving gears are placed entirely within the column, there being no overhanging change-gear box on the side of the machine; the lubrication is of the automatic visible type, supplying oil to the bearing surfaces of the entire machine; the levers for starting, for speed control, for feed engagement and variation, and for ram and stroke adjustment are all easily reached by the operator without leaving his working position; direct-reading indicators for speed, feed, and length of stroke are provided; the main crank-gear is of the helical type, semi-steel, and made in one piece; all other gears are made from alloy steel, and heat-treated; the machine is completely guarded both for the operator's protection against danger from moving parts and belts, and for the protection of sliding surfaces against chips.

The Drive

The drive is of the single-pulley type, with a friction clutch and brake, the pulley shaft being mounted on Timken roller bearings to provide a bearing that will carry the overload due to an unnecessarily tight belt. The machine may be driven either by belt or by a motor mounted directly on the machine. The construction permits the motor to be attached to the machine without difficulty at any time. The proper range of cutting speeds can be obtained by a motor making 1800 revolutions per minute.

The speed gears, placed within the column, as mentioned, slide on integral multiple-key shafts, supported at both ends, making a compact and rigid arrangement. The gear chamber, as shown in Fig. 5, and at *A* in Fig. 3, forms a reservoir for the oil used in lubricating both the drive gears and the remainder of the machine. Eight selective changes of speed are provided, ranging from 11 to 138 cutting strokes per minute, on the 16-inch machine, and from 8 to 102 on the 32-inch machine. These are obtained through two levers within easy reach of the operating position.

The length of stroke is both changed and maintained without the usual clamping nut, the purpose of the nut being fulfilled automatically. The indicator shows the setting for the length of stroke, irrespective of whether the machine is running or not.

The Feeding Motion

The unique feature of the feeding motion is that it is actuated by cams and not by an eccentric motion. This provides for a gradual rather than an abrupt feed, and

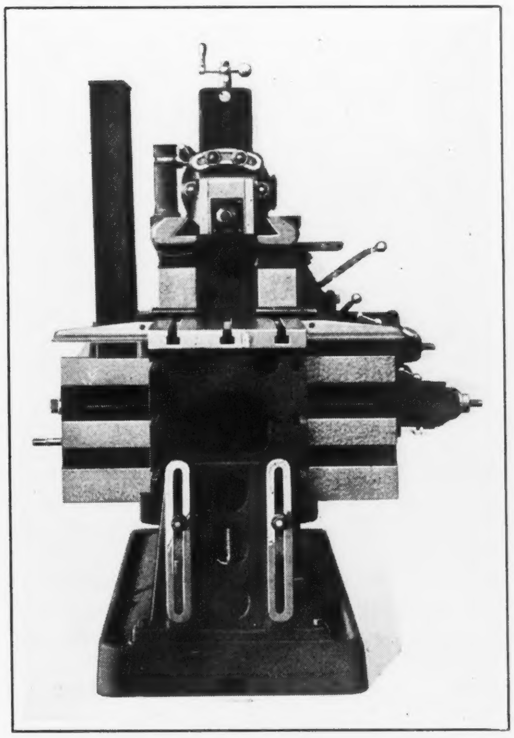


Fig. 1. Front View of the New Cincinnati Shaper

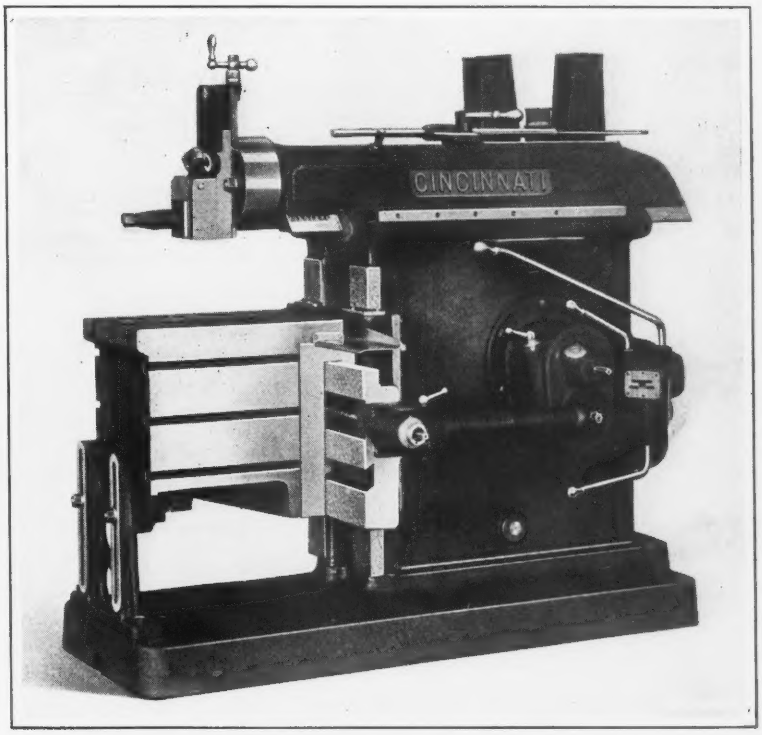


Fig. 2. Cincinnati "Climax" Shaper with Internal Transmission

confines the entire feed under any condition wholly within the return stroke. Another feature of the general feed arrangement is the omission of the usual feed-box on the end of the cross-rail, and the transfer of this mechanism to the side of the column, where it does not encroach upon the operator's working space.

Eleven feeds ranging from 0.010 to 0.170 inch are provided. The feed variation is conveniently accomplished by means of a lever, mounted on a direct-reading dial which indicates the feed in thousandths of an inch. The feed-engagement lever has the three positions, "stop," "right-hand," and "left-hand," indicating the direction of the table movement. A friction safety device protects the mechanism from injury caused by allowing the table to feed to the ends of the rail.

Ram and Column Design

The ram is of the V-type, and has an adjustment by means of a full-length taper gib which is actuated by a single screw. The V-type ram has been adopted as a result of a series of cutting tests conducted with square and V-type ram shapers. Experience indicates that there is but little preference between the two types with respect to cutting action, both being satisfactory when properly adjusted. The determining factor, however, in favor of the V-type is that this construction makes it possible to have both sides of the ram ways in the column cast solid with it, and to provide complete adjustment to the ram ways by means of a single screw, thereby taking care of any play in either a sidewise or a vertical direction. A guard forming part of the ram prevents dirt from working its way into the bearing.

The tool-slide, instead of being made as at *A*, Fig. 4, is made as shown at *B*, which gives much greater strength and prevents the breaking of the slide at *C*. The toolpost has been made unusually large, and is provided with a screw having a head the same size as on the vise, permitting the use of the long wrench for holding large tools tightly. A distinctive feature of the column is the heavily ribbed, dish-formed side, which resists deflection resulting from the thrust on the crank bearing.

Design of the Crank Gear and Bearing and Rocker Arm

A separate crank-gear bearing permits a solid crank gear and makes possible a replaceable bushing as in other bearings. The crank gear, as mentioned, is of helical type to insure finish cuts on the work free from chatter marks. The tooth proportions adopted eliminate under-cut in the pinion, provide full contact in action, and at the same time give equal strength to the teeth in gear and pinion of different materials. The crank-gear journal is long and of two diameters, the purpose of the enlarged portion being to provide additional strength and bearing surface at the point of greatest strain, while the length of the smaller portion maintains the alignment.

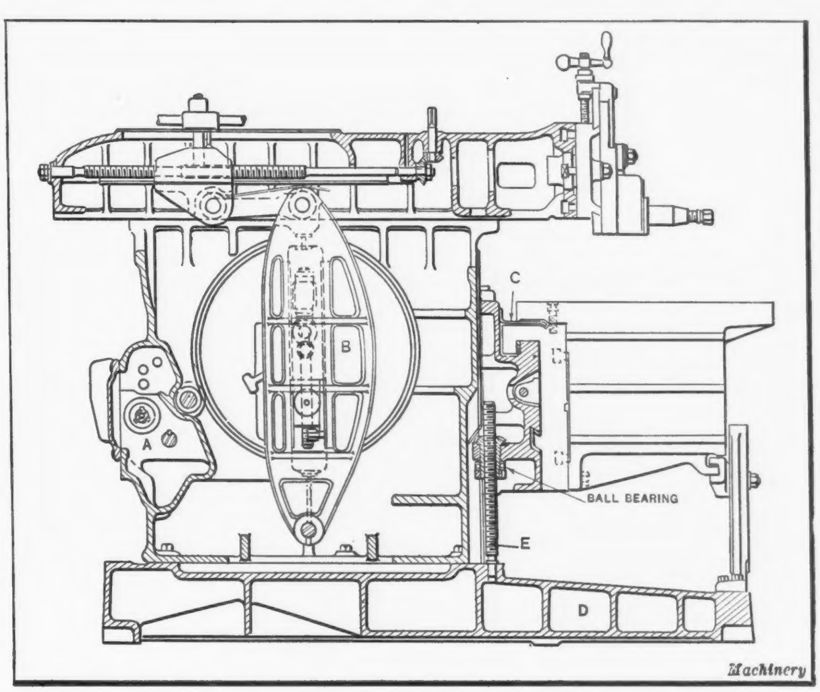


Fig. 3. Cross-section of Shaper, showing the General Arrangement of the Machine

Another feature is the close proximity of the crank-gear bearing to the rocker arm. In addition, the gear portion of the wheel is made to further overhang the bearing, thus bringing the driving load more within the bearing. The crank-pin, which is made of drop-forged steel, hardened and ground, is held in a dove-tail slide of the crank gear by a taper gib.

The rocker arm is of a closed type, of the general form shown at *B*, Fig. 3. It is fulcrumed at the bottom, and connected to the ram by a link. The fulcrum and link pins are hardened and ground. The sliding block is of gray iron, having a hardened and ground steel taper gib on its driving side to compensate for wear. Thus there is a hardened steel crank-pin bearing in the cast-iron sliding block, and a hardened steel crank-block gib bearing against the semi-steel rocker arm, affording very favorable bearing conditions.

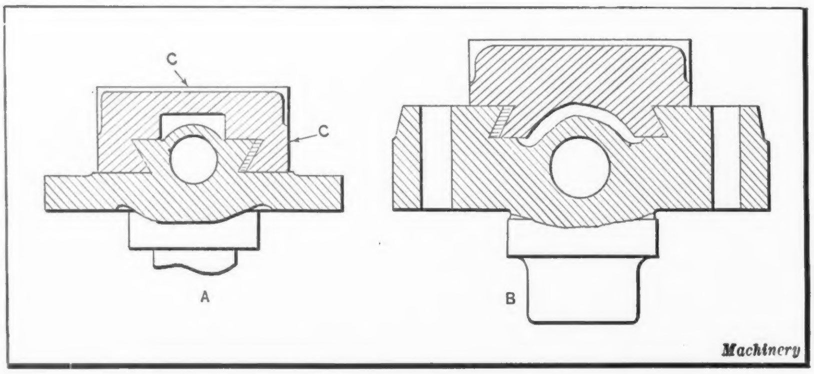


Fig. 4. Comparison of the Tool-slide Design with a Common Construction

Cross-rail, Apron, and Table

The cross-rail is "square-locked" to the column, a type of clamping best suited to resist direct thrust of the cut. Side alignment is maintained by a taper gib, and felt wipers remove any dust from the face of the column while adjustment is being made. The vertical screw *E*, Fig. 3, is stationary and made in one piece, and the thrust of the revolving nut is taken by a ball bearing. The screw does not project below the floor level. A guard *C*, Fig. 3, protects the rail bearing from chips. This guard does not decrease the working surface of the table nor interfere with the operator.

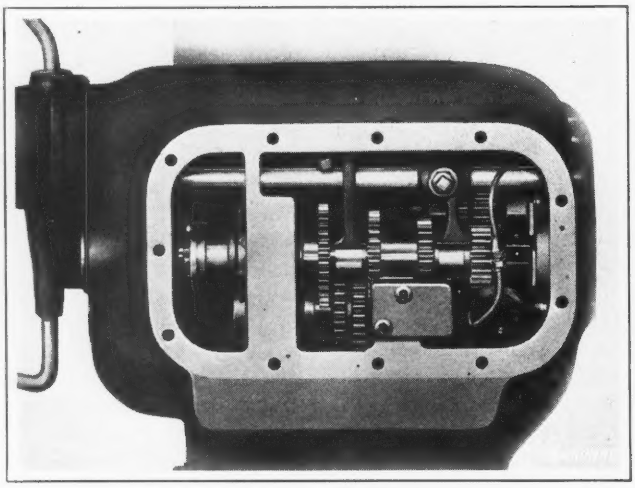


Fig. 5. View of the Gear Chamber in the Rear of the Column

The apron has T-slots in it for holding work when necessary. These T-slots do not run across the entire width, but leave reinforcing ribs at the center and sides, thus providing a much stiffer member than would otherwise be the case. The apron is secured to the long narrow guide of the cross-rail by taper gibs at the top and bottom.

The table is of practically complete box section, having but small openings in the front and bottom. It is secured to the apron by six bolts. The spacing of the T-slots is such that the vise will fit either the top or the sides. The table support is of improved design, the sliding action taking place at the bottom of the table instead of at the base. With this type of support, parallel action is not dependent upon the exact alignment of the base. Protection against chips and dirt is complete. The base, to be of value in supporting the outer end of the table, must be designed to resist deflection, and, therefore, is made of box section, as shown at *D*, Fig. 3, at the point of greatest stress. The base is closed at the top and serves to catch oil dripping inside the column.

Provisions for Lubrication

Particular attention has been given to the matter of lubrication, and the thorough protection of all bearings. The lubricating system consists of a plunger-type pump in the gear-case *A*, Fig. 3, which delivers oil to the sight-feed distributing station on the top of the column, near the belt guards. This pump takes oil through a large bell-mouthed inlet at a high level, assuring a low velocity in the oil approaching the pump and thus permitting any sediment to settle before being drawn into the pipe circuit. The level of the oil in the gear-case is visible through a glass gage. A surplus of oil is furnished to the distributing station, and in returning to the pump, this surplus floods the main gear bearing and the feed mechanism. Wicks in the distributing station feed pipes leading to all parts of the machine, including the ram, ram-link, and rocker arm, the wick method being an additional assurance of clean oil. Both the overflow oil and the drip from the wicks are visible in the distributing station. When the machine stops, the supply of oil is drained from the wicks.

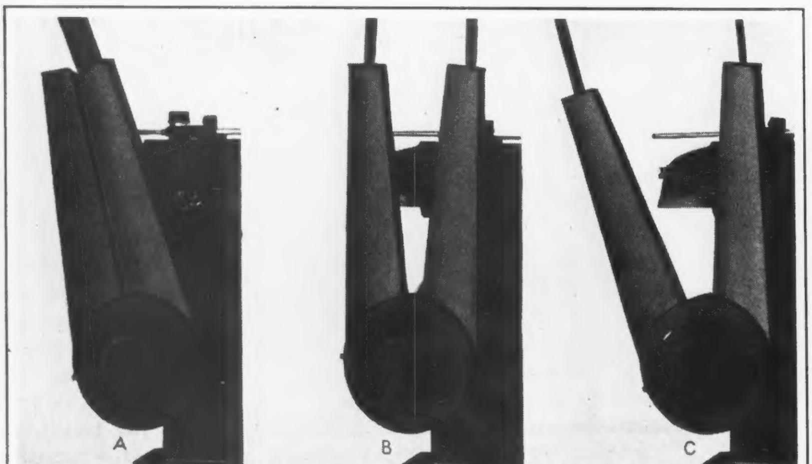


Fig. 6. Adjustment Possibilities of the Belt and Pulley Guard

The belt and pulley guard, as shown in Fig. 6, is easily adjusted to any belting condition. At *A* is shown the arrangement for a crossed belt; at *B*, for a belt to a pulley directly overhead; and at *C* for an unusually large pulley on a lineshaft at the rear. This line of shapers is known as the Cincinnati "Climax" and will be built in seven sizes as follows: 16-, 20-, 24-, 28- and 32-inch heavy-duty type, and 20- and 24-inch standard type.

"BELTEX GRIPSTICK" BELT DRESSING

A new belt dressing in bar or stick form, known as "Beltex Gripstick," is made by the Chicago Belting Co., 127 North Green St., Chicago, Ill. This dressing is applied

to a belt to stop slippage and make it pliable. When a belt is slipping, the end of the "Gripstick" bar is simply held against the pulley side of the belt for about one minute, with the belt in motion. It is said that the slipping will then stop because of the belt gripping the pulley. The friction of the cardboard cone in which the dressing is contained cleans dust from the belt and helps to distribute the dressing evenly. The dressing should be allowed to work itself into the leather before making a second application, and the belt should be treated until it becomes soft and pliable. It is recommended by the maker that this dressing be applied whenever the belt starts to slip, or appears to be getting dry, hard, or covered with dirt. The dressing is made in sticks measuring 2 inches wide by 10½ inches long, and weighing 1 pound each.

WALKER SINGLE-STROKE SURFACE GRINDING MACHINE

An improved single-stroke surface grinding machine, known as type D, is being introduced on the market by the O. S. Walker Co., Inc., Worcester, Mass. In this machine the work is placed on the rotary magnetic chuck, and as the wheel-slide feeds down, it automatically closes the electric circuit through the chuck, operates a clutch which starts the chuck rotating, and brings the grinding wheel in contact with the work. The removal of stock continues until the downward movement of the wheel-slide is arrested by a fixed stop. When the grinding operation is completed, the raising of the wheel-slide automatically stops the chuck rotation, breaks the electric circuit through the chuck, and for an instant closes this circuit in the opposite direction, thereby demagnetizing the chuck face and facilitating the removal of work. Parts can be put on or removed from the chuck only when the wheel-slide is at the upper limit of its travel, and with the wheel-slide in this position, a fixed guard attached to the water pan protects the operator from the grinding wheel.

The thickness of finished work is determined by the location of the magnetic chuck, which can be adjusted vertically to any desired position within the range of the machine, through the medium of the elevating handwheel on the right-hand side. With the position of the chuck determined by the finished thickness of the first piece ground, more pieces of the same type can be ground to the same thickness by lowering the wheel-slide the distance permitted by the fixed stop. The only adjustment required is raising the magnetic chuck from time to time to compensate for wear of the grinding wheel.

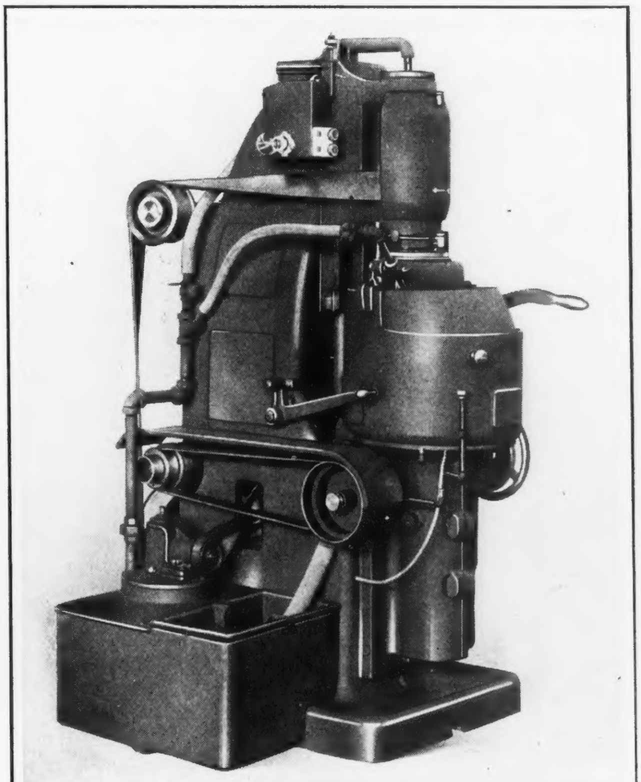


Fig. 1. Walker Single-stroke Surface Grinding Machine

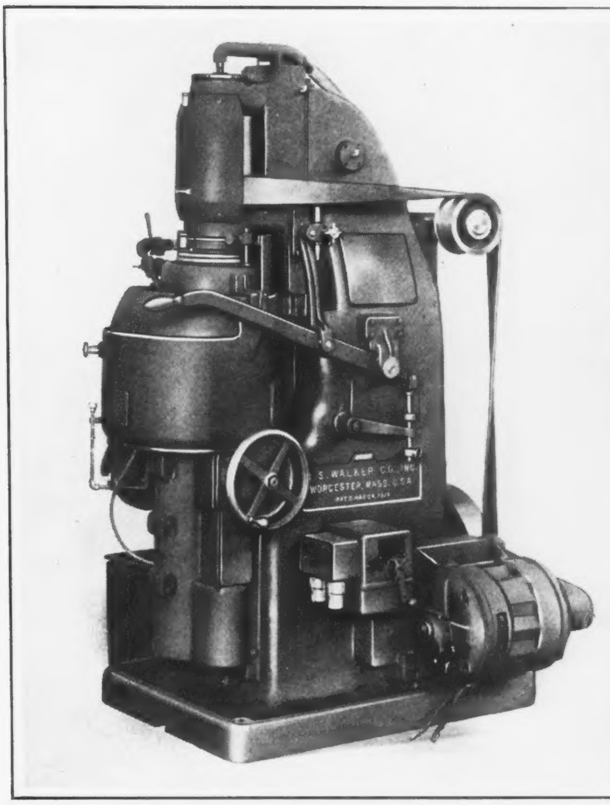


Fig. 2. Right-hand View of Machine which grinds Concave and Convex as well as Flat Surfaces

Control of the Wheel-head

Two mounted cup-shaped grinding wheels, 8 inches outside diameter, are furnished with the machine for grinding steel and cast iron, respectively. The grinding wheels are centered in a cast-iron ring, and clamped to it by means of a bronze ring and four screws. The substitution of wheels, as is necessary in changing from grinding steel to grinding cast iron, for example, is easily accomplished, as the wheel mounting is simply attached to the wheel faceplate with screws.

A diamond set in a bronze holder is furnished with each machine for use when a new wheel is put into service, and for truing the wheel when an exceptionally fine finish is desired on the work. Ordinarily, if a wheel suitable for the work is selected, the first truing is all that is required. The wheel-head is accurately counterbalanced, and the counterweight sheave is carried on ball bearings. The movement of the wheel-head is controlled by a hand-operated lever on the right-hand side of the machine.

There is a hole through the center of the spindle to provide for the delivery of water to the inside of the grinding wheel. Both the upper and lower ends of the spindle are carried in radial thrust ball bearings, and suitable oiling devices are employed to maintain proper lubrication of these bearings. Compression springs in the upper spindle housing overcome the combined weight of the wheel-spindle and all revolving parts connected with the spindle, and also maintain the necessary upward thrust of the spindle in the lower thrust bearing to insure accuracy in grinding. The wheel-spindle pulley is driven by a belt running over ball-bearing idlers from a pulley on the main drive countershaft. This countershaft is located at the back of the machine and also runs in ball bearings to reduce friction. At a speed of 2200

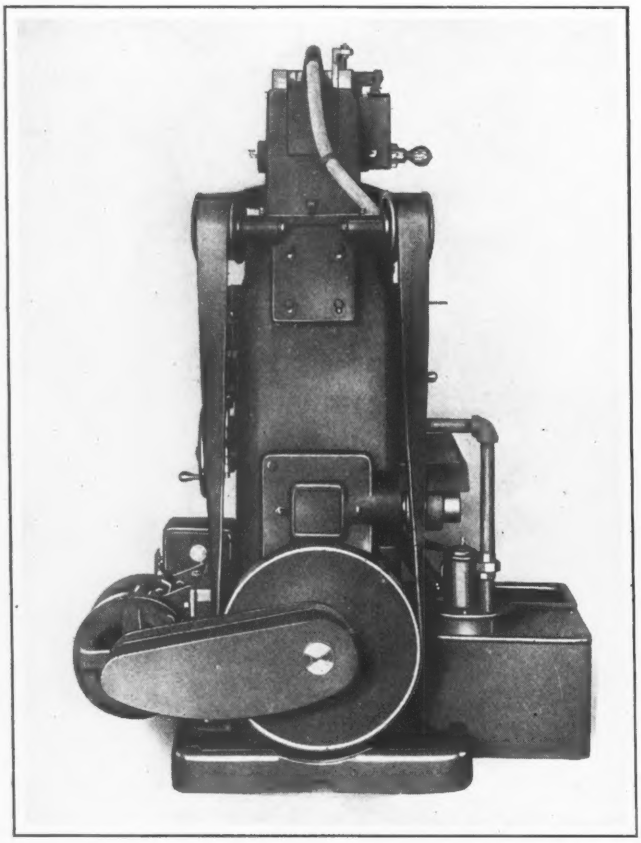


Fig. 3. Rear View of a Walker Motor-driven Grinding Machine

revolutions per minute for the spindle, 10 horsepower is available at the grinding wheel.

When arranged for a belt drive, the machine is of the single-pulley driven type, a belt from a lineshaft being connected to a pulley carried on ball bearings on the hub of the driving pulley previously mentioned. An expanding friction clutch serves to start and stop the machine. In the motor-driven machine, the motor is mounted on the side of the column, as seen in Fig. 2, and the driving pulley of the belt-driven machine and the clutch are omitted, the machine being driven through sprockets and a silent chain, as illustrated in Fig. 3. The motor-driven machine is recommended by the manufacturer, as an individual drive insures constant speed of the grinding wheel. The machine is best adapted for being driven by a 7½-horsepower motor running at 1750 revolutions per minute.

The Magnetic Chuck

The vertical movement of the magnetic chuck, effected by the handwheel at the right-hand side of the machine, is 4 inches. This handwheel acts through miter gears and an elevating screw. A disk graduated in thousandths of an inch is mounted on the same shaft as the handwheel, to provide for adjusting the chuck accurately, as previously mentioned. The chuck is mounted on a vertical spindle, carried in a sleeve in which the spindle has a long bearing. The upper end of the chuck spindle rests in a taper bearing of ample proportions to insure minimum wear and accurate alignment, while the lower end is carried in a radial ball bearing.

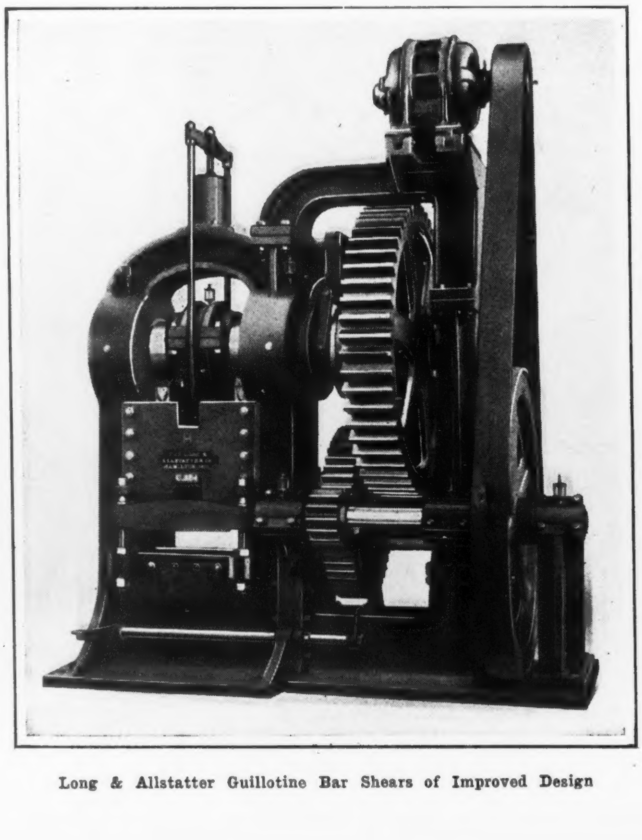
The position of the supporting member on the column is determined by a large stud that projects from the face of the column and has a ball end which engages in a straight reamed hole in the back of the supporting member near the top of the casting. Another stud projects from the face of the column near the bottom in line with the upper stud, and two thrust screws in the supporting member bear on opposite sides of this stud to provide for adjusting the chuck with reference to the grinding wheel. The supporting member is attached to the column by three opposing screw supports which constitute a three-point bearing. In combination with the two thrust screws, these supports permit alignment of the chuck with the grinding wheel, and adjustment of the chuck for grinding either convex or concave surfaces. Rotation of the chuck is controlled automatically through the movement of the wheel-slide, or independently by means of a lever on the left-hand side of the machine.

The standard Walker magnetic chuck used on this machine is so designed that the number and shape of the poles in the top plate can be arranged to meet special conditions. Water guards on the chuck and in the water pan effectively protect the chuck and electrical connections against moisture. The electric current is carried to the interior of the chuck through contact rings on the under side of the body. The lead wires are protected by a flexible metal conduit which passes inside the column up to the demagnetizing switch near the top. The column is a single casting, designed along the lines prevailing in vertical milling machine construction. In addition to the large volume of water directed through the spindle to the inside of the grinding wheel, where it is distributed by centrifugal force over the surface being ground, a second stream is available outside of the wheel. This is particularly useful in cleaning the chuck face preparatory for the next load. The water tank is an independent unit at the side of the column, and has a capacity for fourteen gallons. The pump is of the centrifugal type, ball-bearing, and driven by a belt connected through the column from the chuck-drive countershaft.

Some of the principal specifications are as follows: Range of work under new wheel, 12 inches in diameter by 7 inches high; diameter of magnetic chuck, 12 inches; chuck speeds, 30, 50, and 75 revolutions per minute; weight of belt-driven machine, 4000 pounds; and weight of motor-driven machine, 4200 pounds.

LONG & ALLSTATTER SHEARS

A redesigned line of bar shears of the guillotine type is being brought out by the Long & Allstatter Co., Hamilton, Ohio. The particular aim in improving the design was to obtain machines as rugged, compact, and free from flexure as possible for shearing off square, round, or flat bars under present-day production requirements. To attain this end, the main frame or housing is made from a one-piece casting of box design, an annealed steel casting being used for the



Long & Allstatter Guillotine Bar Shears of Improved Design

large machines and a semi-steel casting for the smaller ones. Tests conducted over a period of several months have shown an increased endurance of the cutting edges of the blades, which is mainly due to the rigid construction by means of which alignment of the blades is maintained. The steel slides are long and operate in bronze-lined bearings. They are counterbalanced either by air, springs, or weights that operate beneath the floor level.

Steel gears with machine-cut teeth are used, and they are placed at the side of the machine in order to give an unobstructed working space around the front, back, and one side. The shaft bearings are extra large, and none of the gearing is overhung. There is an improved automatic stop for operating the clutch, which brings the slide to rest with the blades completely open. This stop is provided with a safety locking feature, so that the clutch will engage the driving jaws only when the operating treadle is all the way down. The machine can be stopped after each stroke or run continuously, as desired.

The flywheel of each machine is sufficiently heavy to relieve the motor or other driving medium from the high peak load to which this type of machinery is subjected in cutting off work. The pendulum or pitman on the larger machines is of the oscillating type, while on the smaller sizes a sliding block is used. This line of machines is self-contained, all parts being supported on a common base to insure the alignment of the entire equipment. The machines are built in a range of sizes for cutting off from 1½- to 7-inch square cold steel.

CINCINNATI THREE-WAY OPEN-SIDE PLANER

A special planer equipped with a bed having two vees and a flat way, as illustrated in Fig. 2, has recently been built by the Cincinnati Planer Co., Cincinnati, Ohio. The box table of this machine has five T-slots for clamping work, and is provided with a table clamp and inner guides to avoid any possible chance of the table tilting or lifting out of the track. All ways are provided with forced lubrication, which is accomplished by means of a reversible pump that forces oil into the ways directly under the tools. The oil is settled and strained, before using again, to avoid getting dirt into the ways. The rail is of the extended type, and so constructed as to take care of strains or cutting at the extreme end. The knee has the same outline as the rail and is bolted and doweled securely to it. Large T-slot blocks, extending the full length of the knee bearing, are used for clamping the knee against the column.

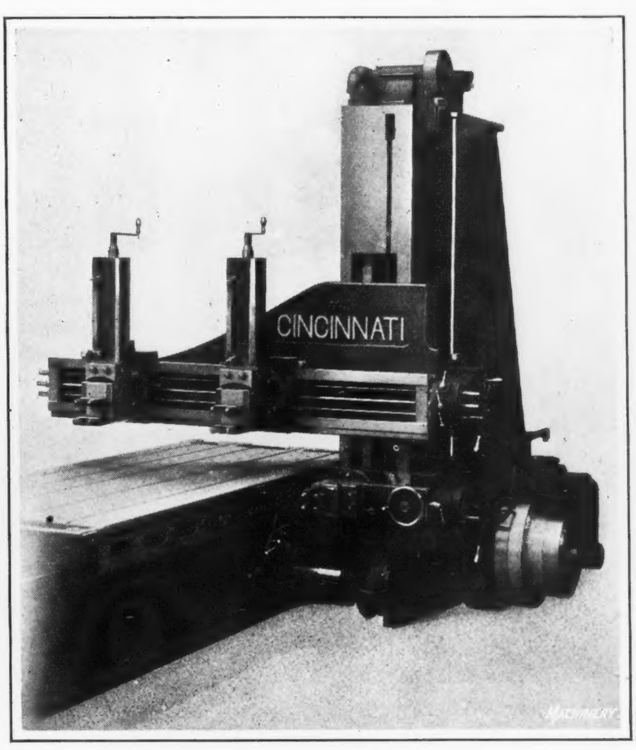


Fig. 1. Cincinnati Open-side Planer

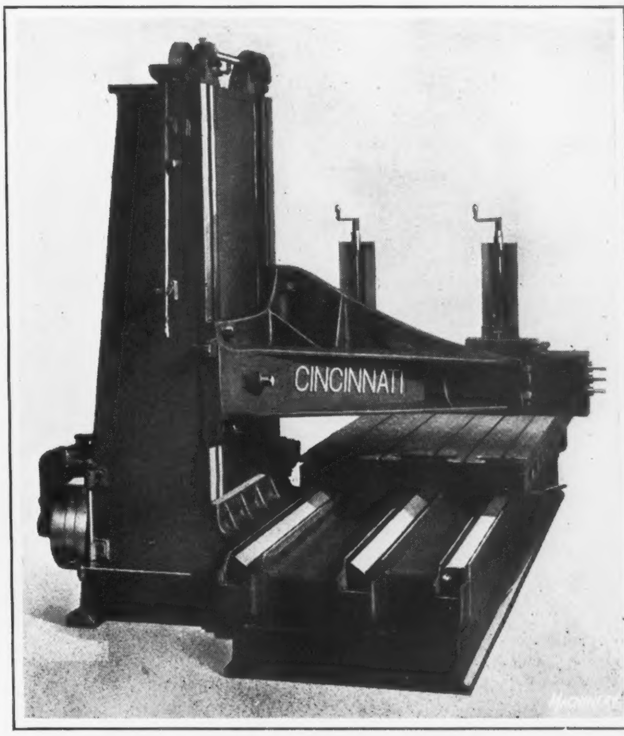


Fig. 2. View showing the Three-way Construction of the Bed

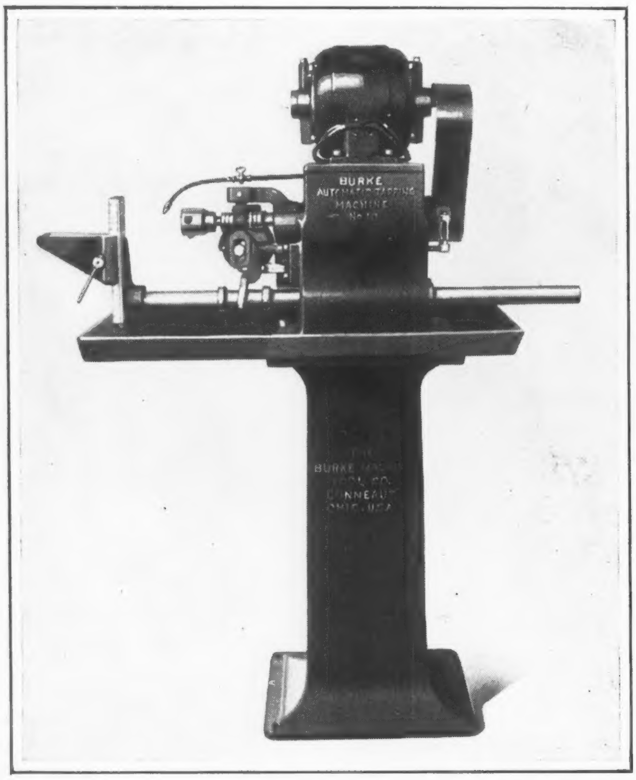
The rail heads have a rapid power traverse in all directions, and are unusually long so that they can plane a considerable distance below the rail. With this construction, the slide has a full bearing on the harp at all times, and the down-feed screw is always in tension. The rail is provided with a power elevating device for raising and lowering, and a limit stop prevents raising the rail beyond its maximum height.

This machine is equipped with a rapid power traverse to the side-head, which allows the operator to raise and lower the rail-heads by pulling the rapid traverse lever in the direction in which he wants the heads to go. The side-head slide is equipped with a handwheel for feeding. The column is braced and ribbed on the inside so as to prevent distortion. In addition to being bolted and doweled to the bed, a large tongue, cast integral with the bed, fits a groove in the column to provide against moving.

BURKE AUTOMATIC TAPPING MACHINE

For use in tapping holes up to ⅝ inch, either right- or left-hand, the Burke Machine Tool Co., 516 Sandusky St., Conneaut, Ohio, has developed the No. 10 automatic tapping machine here illustrated. A feature claimed for this machine is easy operation. Two types of drive are furnished, a cone-pulley drive from a countershaft, and an individual motor drive that is connected by silent chain to a sprocket on the main driving shaft. The latter furnishes power for two purposes; first, to drive the spindle in both forward and reverse directions, and second, to operate the tripping mechanism for automatically reversing the direction of spindle rotation when the tap has been advanced to the point where the operation is completed, or where it has been backed out of the hole.

There are two sets of gears in the drive to the spindle, the first of these being a pair of spur gears which effect a speed reduction and drive the tap forward at a slow speed. The second pair is provided with an idler between the driver and the driven gears, so that the direction of spindle rota-



Burke Automatic Tapping Machine for Right- or Left-hand Threads

tion is reversed. In each of these, the final gear on the spindle runs free and carries a cone clutch. Splined to the spindle between the two cones there is a sliding member which may be engaged with either cone to provide for driving the spindle forward or reversing it.

Different tables can be furnished according to the work to be operated on. The table is mounted on a horizontal bar which is splined in the frame of the machine and is free to move lengthwise. Work is put on the table and pushed up to the tap by hand, after which the operation proceeds automatically. As soon as the tap has taken hold of the work, it leads itself into the hole until the desired depth is reached, when an automatic trip causes engagement of the reverse drive for backing out the tap at high speed.

From the main driving shaft power is also transmitted through worm-gearing to a crankpin revolving in a slotted link which is free to oscillate between two ball-bearing thrust collars on the tapping spindle. When the oscillating link is moved forward to engage the front thrust collar, it clutches the "direct-drive" gear to the spindle for the tapping operation. When the link is moved back to engage the second thrust collar, the reverse gear is clutched to the spindle to back out the tap. The drive to the crankpin is engaged and disengaged by means of two adjustable collars on the bar that supports the table, these collars providing for the reversal of the tap at any required point. At either end of the sliding movement of the table one of the collars engages a small crank, the turning of which raises a latch. When the latch is disengaged, a compression spring causes the engagement of a positive-jaw clutch for driving the crankpin previously mentioned.

The movement of the crankpin rocks the oscillating link to engage the proper thrust collar for throwing the clutch of the reverse gear into mesh. Then, after the spindle has backed out the tap, the second collar of the table bar engages the trip to release the latch, so that a barrel cam may disengage the clutch which transmits power to the crankpin. When the cam has disengaged the clutch, a small spring snaps the clutch away from its mating member and prevents the jaws from contacting. The shape of the crankpin is such that after the actual disengagement of either the forward or reverse drive, the crankpin acts as a cam to send the tap forward or draw it back through a distance of about three threads on the work.

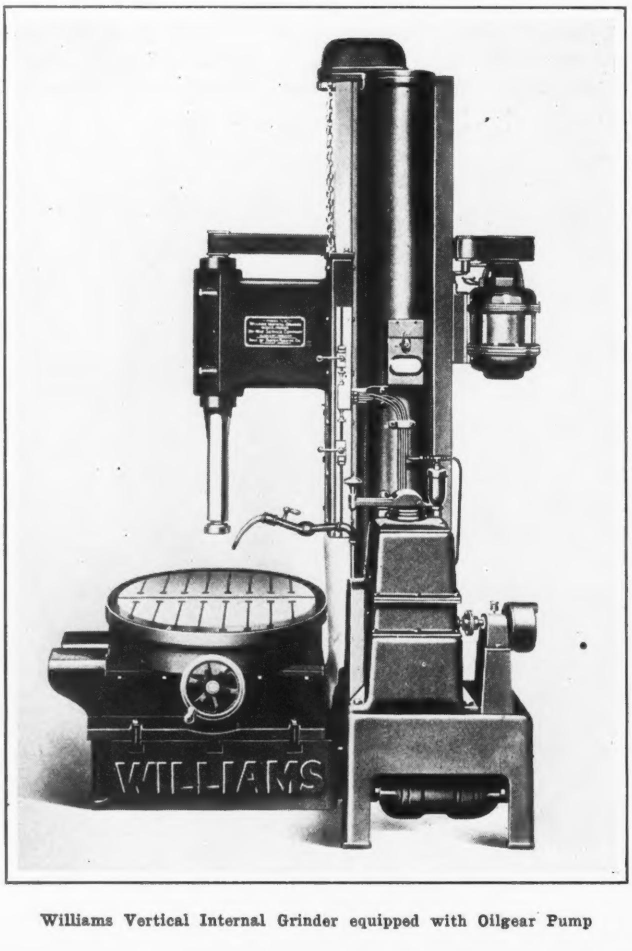
WILLIAMS VERTICAL INTERNAL GRINDER

A vertical internal grinding machine has been placed on the market by the Hy-Way Service Co., 1100 Beardsley Ave., Elkhart, Ind., which is of the same general design as the cylinder grinder described in November, 1922, MACHINERY, except that it is equipped with a circular revolving table. Since the publication of the description mentioned, the cylinder grinder has been furnished with an Oilgear variable-feed hydraulic pump. This permits any desired feed of the grinding wheel to be obtained instantly, as well as an automatic reverse, and a rapid traverse for raising the wheel from the work. This pump is also furnished on the internal grinder, and is located at the side of the column and driven by a one-horsepower motor.

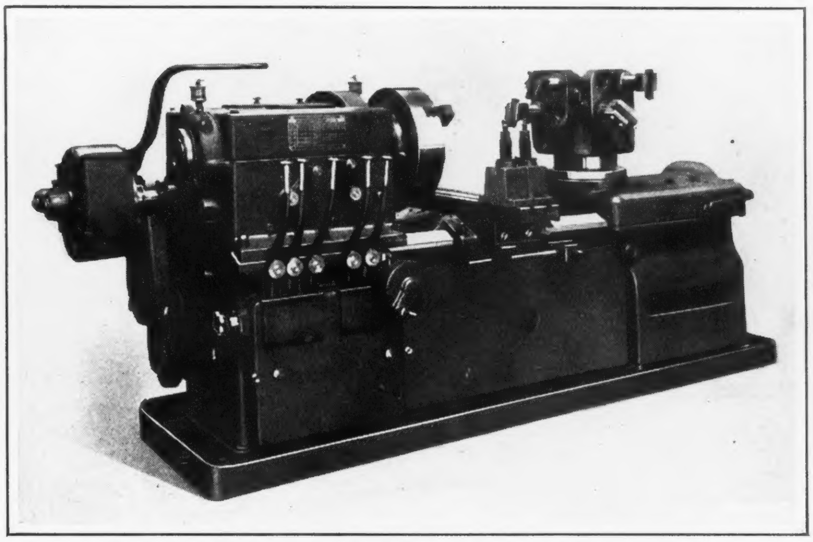
Oil is circulated under pressure to a hydraulic arm, and any rate of feed is obtained by simply moving a control handle to the proper position. The head then feeds up and down, reversing automatically at the ends of the stroke, which is adjustable by means of stops. A suction fan for removing chips and dust is mounted on the same base as the pump on the cylinder grinder, and driven from the same motor by a belt.

The grinding spindle is driven by a two-horsepower vertical-type motor running at a speed of 7000 revolutions per minute. The spindle is carried in three bearings, the top one being a double-row annular ball bearing which carries the weight of the arbor and the thrust. The drive from the motor at the rear of the head to the spindle is through a flexible idler which maintains the belt tension. The weight of the motor is used to counterbalance the overhang of the head, and thus reduce friction and wear of the ways.

A pump tank and necessary attachments to carry water to any desired point are provided for wet grinding, and this pump is driven by the same motor that drives the oil pump. The revolving table is mounted on a heavy thrust ball bearing, and is driven by a ¾-horsepower variable-speed motor at the left-hand side of the table base. This motor furnishes three speeds, of 300, 1200, and 1800 revolutions per minute.



Williams Vertical Internal Grinder equipped with Oilgear Pump



Potter & Johnston Manufacturing Automatic Chucking and Turning Machine

The table may be adjusted in and out a distance of 12 inches by revolving the handwheel. The feed of the head may range from 0 up to 5/8 inch per revolution of the work. This machine is intended for grinding holes from 3 1/2 to 20 inches in diameter.

POTTER & JOHNSTON CHUCKING AND TURNING MACHINE

The latest addition to the line of automatic machine tools built by the Potter & Johnston Machine Co., Pawtucket, R. I., is the No. 6-C manufacturing automatic chucking and turning machine here illustrated, which has been designed for the economical production of flywheels, hubs, electric motor parts, and similar duplicate work. The machine is of the unit-type construction with the headstock, turret-slide, feed-box, and cross-slide built in units. The base is of heavy box section, with wide ways. The guiding of the cross- and turret-slides is all done by the front way, which is of a modified inverted V-section that is said to insure accurate alignment of the turret with the headstock. The spindle is made from a high-carbon steel forging.

There are sixteen changes of speed for the spindle, ranging from 9 to 185 revolutions per minute. These speeds are arranged in four sets of automatic changes, and any group of changes can be quickly obtained by means of the hand-levers on the front of the headstock. The automatic changes may be made at any time by a hand-lever on the front of the machine or automatically by means of dogs. All spindle gearing is made of steel, and runs in a bath of oil, while the bearings are flood lubricated. The shafts and heavy-duty gears are made of chrome-nickel steel and heat-treated. The machine is driven by a constant-speed pulley, equipped with a friction clutch and brake.

The feed gearing is driven direct from the spindle, and is contained in a box attached to the rear of the machine. Twenty-four feeds ranging in geometrical progression from 0.007 to 0.250 inch per spindle revolution are obtainable. These feeds are in three groups—coarse, medium, and fine—and each group has an independent set of hand change-gears. Any one of these groups may be engaged automatically by means of a feed-dog or by hand through a lever. The feeds are independent of the high constant speed provided for the idle movements of the turret-slide in withdrawing, revolving, and advancing the tools.

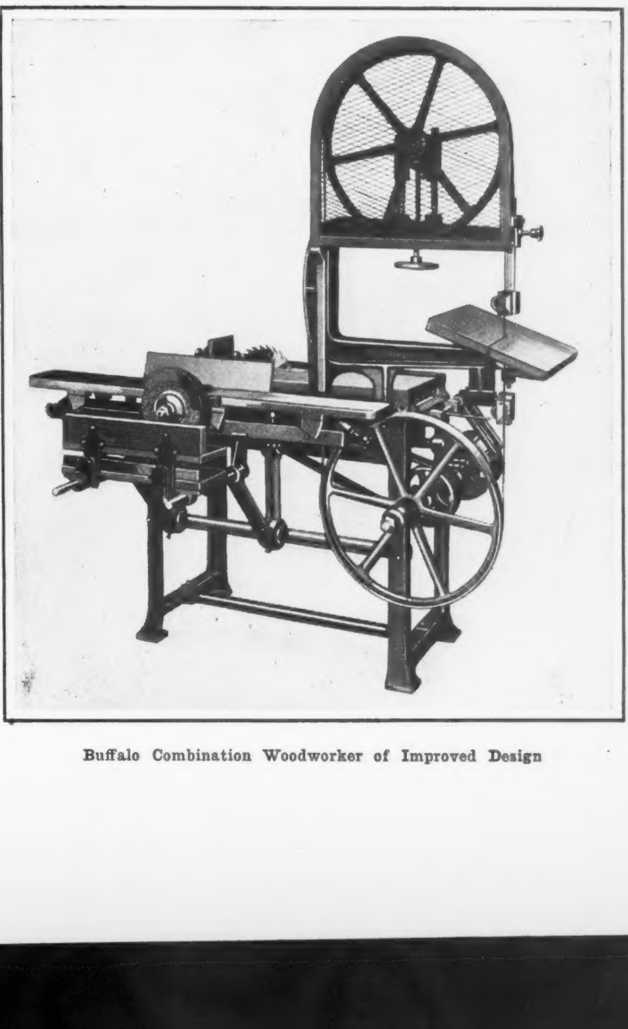
The cam-drum which controls the movements of the cross-slide is located directly under the cross-slide, and a roll stud in the slide makes direct connection between the two. This enables the cross-slide feed to be made the same as the turret feed, and is said to allow cuts to be taken with tools on the cross-slide that are far beyond the limit of the ordinary cross-slide. All thrust on the cross-slide drum is taken by shoes directly in line with the point of contact between the roll and the cam. Special cams may be quickly attached without removing the cam-drum.

The machine may be equipped with a four-, five-, or six-face turret, the standard turret having four faces. The turret is automatically clamped in position, and all parts of the revolving mechanism subject to strain are made of alloy steel and heat-treated. The turret-slide has a longitudinal adjustment by means of a hand-crank and screw, and may be clamped in any desired position by three bolts, besides being located by the adjusting screw. The machine may be equipped with either mechanical or air control, the latter being advisable, because changes are made instantly. An oil-pump and piping and an oiling arrangement for the turret are furnished on machines that handle work requiring a lubricant.

Some of the general dimensions of this machine are as follows: Swing over bed, 29 1/2 inches; swing over cross-slide, 16 inches; travel of cross-slide each way, 6 inches; length of turret-slide travel which permits of supporting or piloting turret boring-bars, 7 inches; turret-slide adjustment, 10 inches; cross-slide adjustment, 10 inches; and diameter of hole through spindle, 3 1/2 inches. From 10 to 15 horsepower is required for driving this machine, and the weight of the machine is about 9460 pounds.

BUFFALO COMBINATION WOODWORKER

Several features have recently been added to the No. 2 combination woodworker manufactured by the Buffalo Forge Co., 144 Mortimer St., Buffalo, N. Y. This machine is intended for such work as rip, cross-cut, and band-sawing; jointing; planing; and drilling. It is equipped with an 8-inch emery wheel, and may be provided with an 18-inch disk sander. A change has been made in the planer guide to furnish a quicker, simpler, and more accurate adjustment. The arrangement consists of a slide which moves the guide forward or backward in a slot or groove in which



Buffalo Combination Woodworker of Improved Design

it is locked in position by means of a thumb-nut. In the older type machine the pulley on the drive shaft was belted direct to a pulley on the jointer and circular saw shaft, but this has been replaced by a positive drive consisting of a rawhide pinion and gear.

The machine is equipped with tight and loose pulleys and a belt-shifter. The pulleys for the jointer and lower bandsaw wheel are also connected to the driving shaft by means of jaw clutches, so that the different parts of the machine can be run independently of each other. The table for the cross-cut and rib saw is 37 inches long by 15 inches wide. This table is hinged at one end, and may be raised or lowered to adjust the depth of cut. The saw mandrel is driven at a speed of 3000 revolutions per minute. The jointer is fastened on the same spindle as the saw and is 6 inches long by 3 inches in diameter.

Both sides of the jointer table are adjustable through a screw and handwheel, and the table sections are 6 inches wide by 24 inches long. The jointer shaft has an outboard bearing beyond which the emery wheel is attached by means of two collars and a nut. There is a reamed hole in the shaft at this end to receive straight-shank drills. To facilitate holding work to be drilled, a table is furnished that is adjustable to different heights. The disk sander may be placed on the lower bandsaw shaft. The bandsaw wheels are 22 inches in diameter, with a 1½-inch face covered by an endless rubber band that reduces slippage of the saw and heat from the blade.

CLEVELAND AUTOMATIC HUB MACHINE

A machine intended especially for finishing automobile hub forgings, such as the one shown in Fig. 2, which has a finished maximum diameter of 7 inches, has been brought out by the Cleveland Automatic Machine Co., Cleveland, Ohio. This machine follows the same general features of design as the Cleveland automatic piston machine, but it embodies special features that adapt it for machining hubs, as will be seen from Fig. 1. The machine can also be quickly arranged for machining second-operation work mounted on an arbor, including bevel gears, bevel-gear housings, pinion-gear shafts, transmission gears, and other parts of a similar nature within its capacity.

The hubs to be machined are placed on an arbor by hand, after which one end of the arbor is chucked in the machine by means of a hand-operated chucking mechanism. The opposite end is supported by a ball bearing in the tool-stock spindle at the rear. The arbor is driven by a boss on the main spindle hood, engaging a lug on the arbor. Several

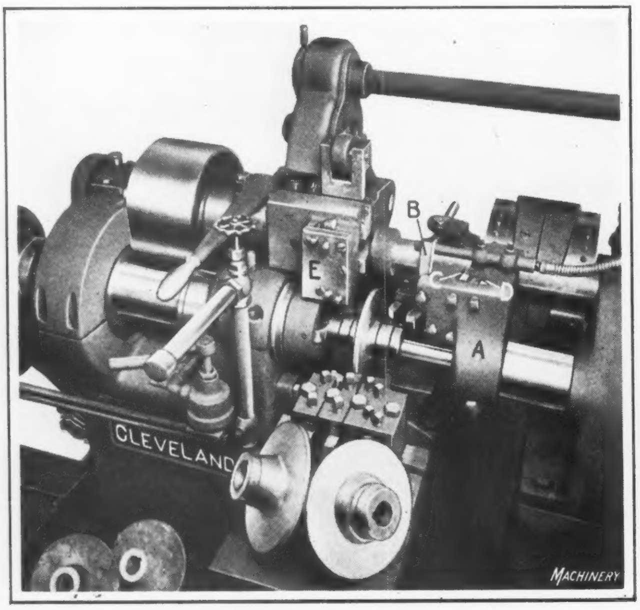


Fig. 1. Cleveland Automatic for finishing Automobile Hubs

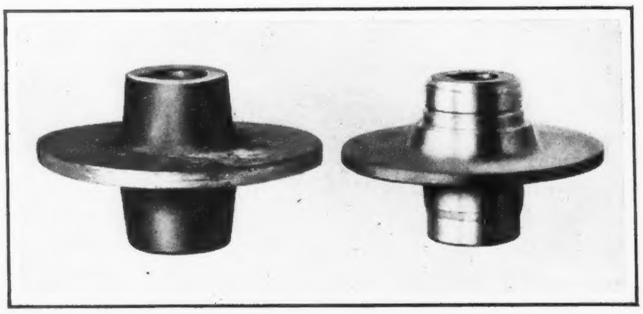


Fig. 2. Comparison of a Rough Hub Forging with a Finished Hub

arbors are supplied for each machine, so that the operator can always have a mounted hub ready to place in the machine as soon as one is finished. After the chucking, all the operations are automatic.

The overhanging arm *A*, mounted on the tool-stock spindle and supported rigidly in the rear, carries three cutters, one of which, *B*, turns the flange and the other two, *C* and *D*, rough-turn the small diameter and face one end, respectively. Simultaneously, three cutters in blocks mounted on the rear cross-slide rough-face the flange and rough-form and face one end. The overhead turning attachment *E*, mounted securely on the spindle head and operating longitudinally from a cam on the camshaft, carries two cutters which next rough-turn the small end of the hub. Finally, four cutters mounted on the front cross-slide finish-form both ends and finish-face the front of the flange. A hub is produced in each cycle of the camshaft.

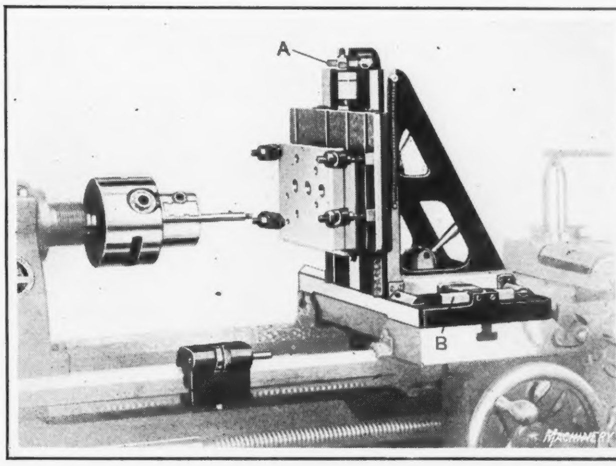
The machine is driven from a single pulley equipped with a clutch which automatically stops the operation as each hub is completed. The machine may also be arranged with a motor drive. The lever for starting and the air control lever are within easy reach of the operator. One man can operate three machines, the total production from which is thirty-six hubs per hour.

CRALEY SPACING AND BORING ATTACHMENT

An attachment intended for application to lathes and milling machines in the tool-room, for spacing holes in boring and drilling such accurate work as jigs, dies, and master plates, has recently been developed by the C. C. Craley Mfg. Co., Shillington, Pa. The attachment eliminates all laying out or the use of buttons to insure accurate results in this class of work. From the illustration it will be seen that the attachment is made up of three principal castings, a baseplate, an angle-plate, which slides horizontally on vees in the baseplate, and a work-holding plate which slides vertically on vees in the angle-plate.

The fixture is equipped with a taper wedge *A* at the top of the angle-plate and a taper wedge *B* at the front of the baseplate. These wedges are hardened, ground, lapped, graduated in thousandths of an inch, and have a maximum adjustment of 0.050 inch. Accurate settings of work are obtained by having a stop-pin on the work-holding plate touch either the top wedge or gage-blocks placed between it and the wedge, and by having a stop on the side of the angle-plate come in contact with the base wedge or with gage-blocks placed between it and the wedge. The work-plate is fitted with a guide or supporting strip at the bottom and two stop-pins on the left-hand side. These pins and strips are high enough to allow for using parallel strips when working on flat work, such as a master plate.

When the work-plate is so set that the stops on both the work- and angle-plates are in contact with the taper wedges and these wedges read zero, the point of intersection of lines passing across the face of the stop-pins and the guide strip coincides with the center of the lathe spindle. With this position established, the preliminary laying out of work is eliminated, as all other locations of the work may be



Craley Lathe and Milling Machine Attachment for Tool-room Use

carefully determined in either direction from this starting point by the use of standard size-blocks in combination with the taper wedges.

Each slide is provided with a scale for getting approximate settings, after which the proper blocks are placed between the stops and the wedges. The slides are then clamped just tight enough to allow the wedges to be moved forward, which, in turn, causes the sliding members to move until the desired readings are obtained. The positions of the work- and angle-plates during an operation are maintained by means of binding clamps at the back. The work-plate is equipped with two coil springs, one on each side, which act as a counterbalance to keep it from dropping when the binding clamp is released in order to reset work.

Two raising or parallel blocks are furnished to support the base when it is desired to use this attachment on milling machines or on a surface plate for use as a lay-out or inspection tool. These blocks are necessary because the under side of the baseplate is deeply webbed to give strength and rigidity. Provision is made to prevent dirt from getting between engaging surfaces of the slides. The micrometer carriage stop regularly furnished with lathes can be used in operations where it is desired to control the depth of the hole being bored.

WALCOTT "LOW-DRIVE" LATHE

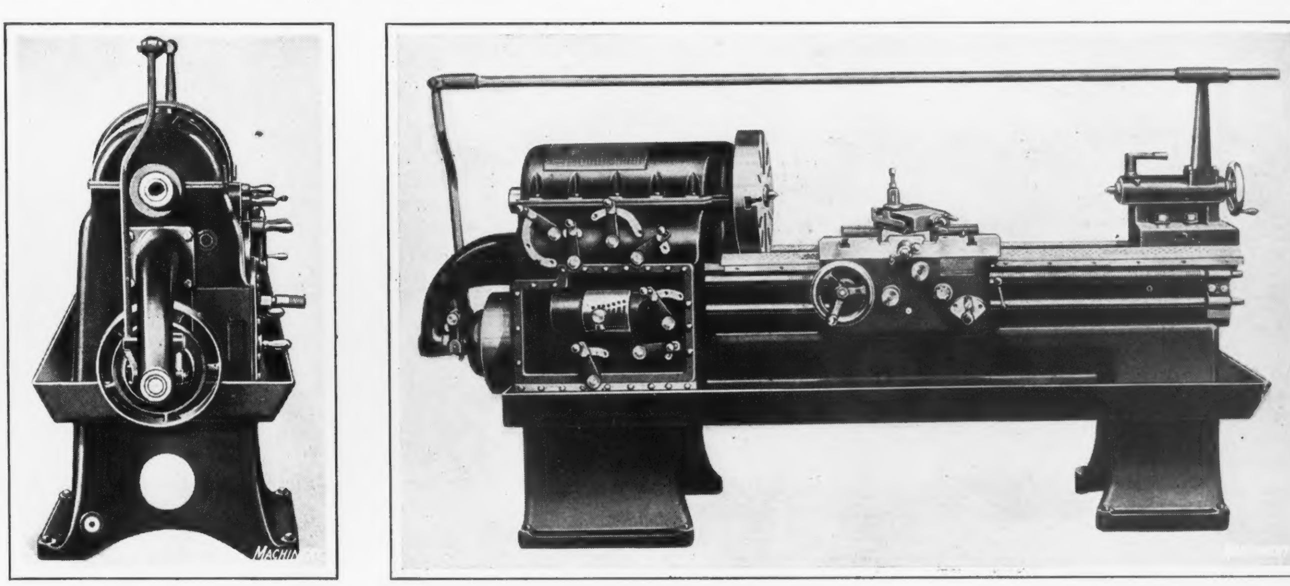
On the "Low-drive" lathe now being placed on the market by the Walcott Lathe Co., 115 Calhoun St., Jackson, Mich., the main feature is the placing of the entire driving mechanism directly under the spindle and below the ways of the bed, which construction is said to balance the lathe and reduce vibration to the minimum. Another important feature is that the headstock, bed, and gear-box, containing the working members of the head, are cast in one piece to insure rigidity and be oil-tight. Also, all gears and shafts are flooded with oil by means of a geared pump, which also insures lubrication of the other working parts. All gears are contained in a single housing that does not overhang, and a three-point bearing insures alignment of the bed.

Forty-two feeds are obtained through three levers, and twelve speeds are obtained through the same number of levers. A lever is also provided to instantly reverse the direction of a feed, as well as a lever for changing from a rod to a screw feed. A departure from previous construction is that on this "Low-drive" lathe the rates of feed are obtained in inches per minute regardless of the spindle speed, instead of in thousandths of an inch per revolution as heretofore. The feed mechanism is driven from a constant-speed shaft, the forty-two feeds ranging from 0.4 to 22.4 inches per minute of carriage travel. Threads of 175 different pitches may be cut on this machine, including all standard threads and many odd threads as well. High-carbon heat-treated steel is used in making all gears and shafts, and bronze bearings are used throughout. This lathe is built in various sizes from 10- to 30-inch swing.

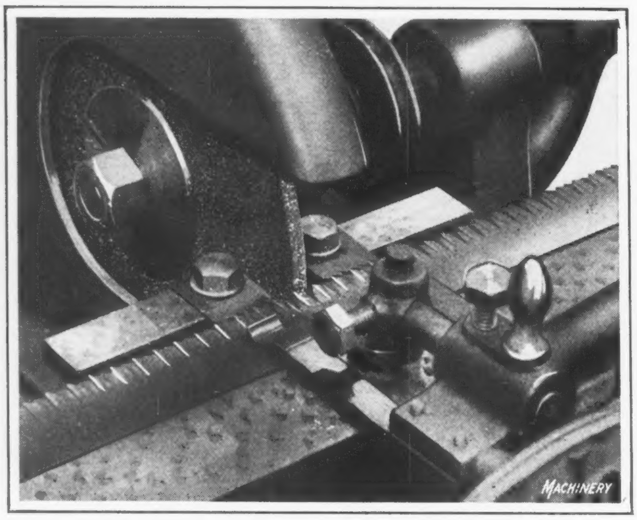
"RAPIDOR" METAL-SAWING EQUIPMENT

Hacksaw blades of unusual design, a sharpening machine intended primarily for use with these blades, and a metal-sawing machine adapted to run at high speed under severe conditions, are all being introduced to the trade by Edward G. Herbert, Ltd., Chapel St., Levenshulme, Manchester, England, under the trade name of "Rapidor." The hacksaw blades are made of high-speed steel containing 18 per cent tungsten, and are hardened throughout. The blades can be resharpened many times until the original teeth have been entirely ground away, as a patented set of the teeth extends beyond their root. It is stated that these blades cut progressively faster after each sharpening, and that they are especially suited to sawing hard materials, including tool steel.

These blades can be sharpened on various grinding machines, but the "Rapidor" sharpening machine is recommended, because on this machine the blade teeth are ground to models or templets that have the correct shape of tooth. These models are located on each side of the grinding wheel, as shown in the illustration, and as the blade moves toward the wheel, its teeth are ground to the proper shape and on



Figs. 1 and 2. Walcott "Low-drive" Lathe with Entire Driving Mechanism located beneath the Spindle



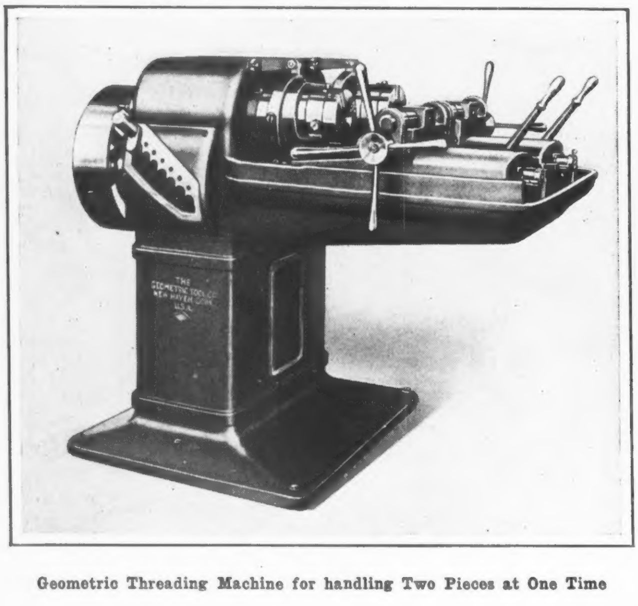
Arrangement of the Saw Blade and Models on the Herbert Saw Sharpening Machine

both faces. The grinding wheel has no movement other than rotation. A diamond rest is supplied for truing the wheel to the proper angle. This machine may also be used for sharpening any size or make of hacksaw blade.

The sawing machine is also designed primarily to use "Rapidor" blades, and is built in two sizes, the capacity of the smaller being for 6-inch round or square stock, and of the larger, for 10-inch round stock and other sections up to 12 by 8 inches. These two machines may be run at a speed of 170 revolutions per minute with a heavy pressure on the blade. Lubricant is provided mechanically to every part of the machine requiring oil, the lubricant being distributed from a central reservoir. The saw-holders are supplied with an indicator that shows when the blade has been strained sufficiently to obviate breakage through incorrect tension. The dashpot is fitted with a device that enables a start to be made on a sharp corner of work without danger of breaking the teeth of the saw.

GEOMETRIC DOUBLE-SPINDLE THREADING MACHINE

A 1½-inch double-spindle threading machine intended for work on which the threading time is sufficient to allow the operator to chuck and start a second piece while the first is being completed, has been added to the line of threading equipment manufactured by the Geometric Tool Co., New Haven, Conn. In general construction, this machine is similar to the ¾-inch double-spindle threading machine



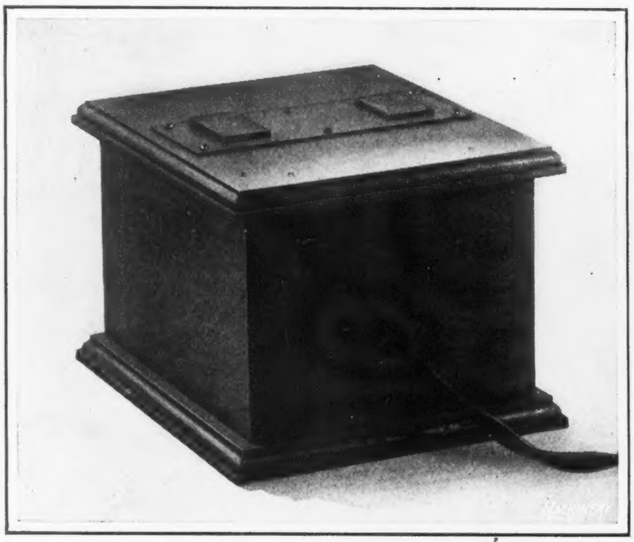
Geometric Threading Machine for handling Two Pieces at One Time

described in March, 1921, MACHINERY. However, the new size handles work ranging from ¾ to 1½ inch in increments of ⅛ inch. The greatest cutting length for which the swinging gage can be set at one time is 9 inches, but by resettings, a length of 14 inches may be obtained.

When the countershaft speed is 296 revolutions per minute, the spindle speeds obtained through the change-speed lever are seven in number, and range from 38 to 74 revolutions per minute. For the class of work mentioned, the double-spindle machines have a production practically double that of single-spindle machines of similar design built by this company. The floor space required for the 1½-inch machine is 48 by 65 inches, and the weight of the machine is approximately 2165 pounds. It can be equipped with a six-horsepower motor drive.

THORN DEMAGNETIZER

A portable demagnetizer designed for use in moderate-sized machine shops and tool-rooms in which magnetic chucks are employed, has been brought out by the Thorn Machine Tool Works, Syracuse, N. Y., and is being distributed by A. J. Littlejohn, 508 E. Genesee St., of the same city. This demagnetizer is portable, and can be operated



Thorn Portable Demagnetizer operated from a Lighting Circuit

directly from an electric lighting socket. It is built for 110- and 220-volt alternating-current circuits. The core is made of sheet-iron laminations with a square copper tube slipped over it and wire coiled around the tube. A three-minute contact with the poles is said to be sufficient to demagnetize any piece.

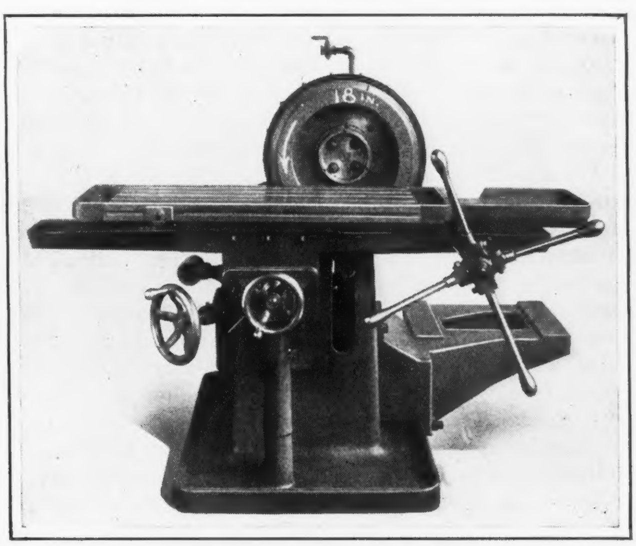
ALOXITE AND CARBORUNDUM REDMANOL CUT-OFF WHEELS

A new bonding agent known as "Redmanol" is being used by the Carborundum Co., Niagara Falls, N. Y., in the manufacture of aloxite and carborundum cut-off wheels. "Redmanol" is a phenol resin of the same family as bakelite, and it is said to give a wheel the combined properties of strength, porosity, hardness, and resistance to wear, as well as making it free-cutting, and providing a bond that does not soften or melt. The aloxite "Redmanol" wheels are recommended for cutting high-speed and alloy steels, stellite, etc., while the carborundum "Redmanol" wheels are intended for materials of lower tensile strength. The popular size of cutting-off wheels is 12 inches in diameter, and this size can be made as thin as 3/32 inch. However, wheels are made with the new bond from 8 to 14 inches in diameter, and from 3/64 to ⅛ inch thick. The wheels are made in different bond grades for the various materials.

In tests conducted with an aloxite "Redmanol" wheel, 12 inches in diameter, 3/32 inch thick, 50K grit, 8 grade, running at 4000 revolutions per minute, a piece of Chesterfield metal, 5/8 inch square, was cut off five times with a wheel loss of 1/16 inch. The average time per cut was 8 seconds. Diamond alloy, 7/8 inch square, was cut at the rate of 10 seconds per cut, and after two cuts the wheel loss was 1/16 inch. A piece of stellite, 2 by 7/16 inch, was cut at the rate of 12 seconds per cut, and the wheel loss after two cuts was again 1/16 inch.

GRAHAM RING-WHEEL GRINDING MACHINE

A grinding machine of the ring-wheel knee type, equipped with an 18-inch wheel, is being placed on the market by the Graham Mfg. Co., Inc., 71 Willard Ave., Providence, R. I. This machine follows closely the design of the 12-inch size manufactured by the same company, which was described in October, 1921, MACHINERY, but it is equipped with a collapsible pilot wheel that makes it possible to grind very long pieces without interference from the handles of the wheel, and there is an auxiliary tank in the column and a bracket for a 15- to 20-horsepower motor. Both machines



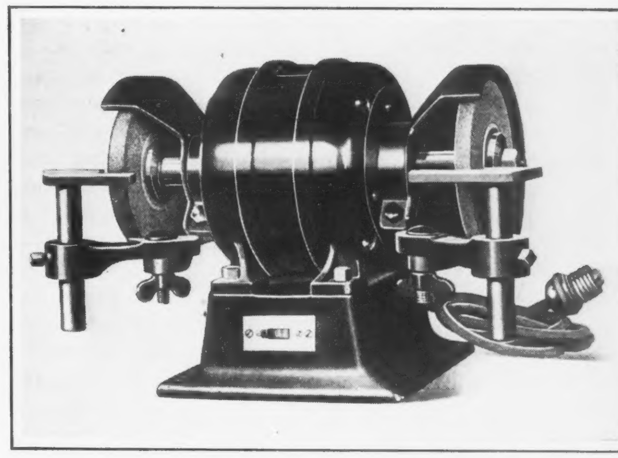
Graham Knee-type Ring-wheel Grinding Machine

are intended for the rapid and accurate production of flat surfaces by wet grinding, and may be belt- or motor-driven.

The cutting is done on the face of the abrasive ring just above the table in the position indicated by the arrow, with the head set to give clearance for the surface opposite the arrow. For special broadside grinding of large area, the head is set square with the work and cutting may be done at any place on the face of the ring. The work is held directly on the table or in special fixtures, vises, magnetic chucks, etc. The top of the table can sometimes be designed to accommodate unusual shapes. Circular work, such as the face of pulleys, segments, arcs, etc., may be ground by locking the table and using some type of rotary fixture with a vertical axis. Concave and convex surfaces may be produced by grinding on the corners of the ring-wheel. The speed of the wheel on the 18-inch machine is from 800 to 850 revolutions per minute, and the height of the machine from the floor to the center of the spindle is 42 inches.

BODINE BALL-BEARING PORTABLE GRINDER

An improved type of portable grinder, intended primarily for use in connection with the departmental system of handling grinding, has been placed on the market by the Bodine Electric Co., 2254 W. Ohio St., Chicago, Ill. The



Bodine Improved Motor-driven Grinder equipped with Ball Bearings

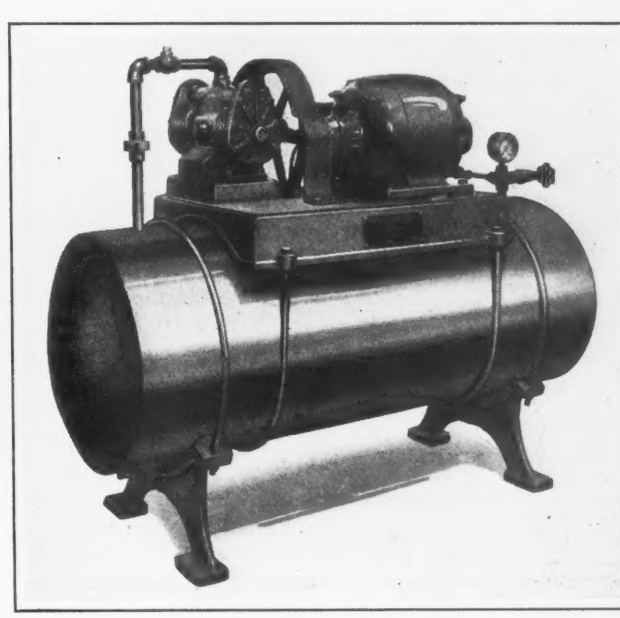
grinder shaft runs in ball bearings located on both sides of the motor. There is a simple screw adjustment to take up any wear that may develop in the ball bearings after a long period of use. The design is said to result in smooth running and accurate grinding.

The tool-rest is quickly adjustable to any position by simply turning a thumb-screw. It may be adjusted up and down as well as swung to the right or left. A dustproof casing protects the motor, and a heavy guard prevents particles of metal and dust from flying toward the operator. The grinder is equipped with an electric cord and plug, and an electric switch controls the current supply. Adequate oiling of the various bearings has been arranged for.

DUNNING AIR COMPRESSORS

New models and sizes have been added to the line of Dunning air compressors built by the George Sachsenmaier Co., 926-932 N. 3rd St., Philadelphia, Pa. The mechanical features of all models are the same, there being but three moving parts. The cylinder, oil reservoir, and base are a one-piece casting, assuring rigidity, compactness, and alignment of the assembled parts. Two cylinders extend horizontally through the length of the casting, and the ends of these cylinders are covered with removable heads and hold the valves. The valves are large to prevent overheating; they are made of steel, bear against cast-iron seats, and have a 30-degree angle.

A long double piston, consisting of one casting, is employed to reach from the end of one cylinder into the other



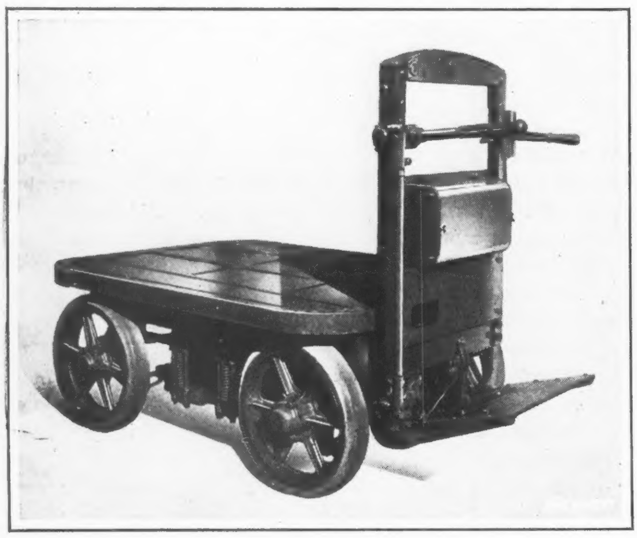
Dunning Automatic Motor-driven Air Compressor

cylinder. The piston is operated back and forth by a hollow eccentric shaft, and the air is compressed at each stroke. As the compressor is double-acting, the flow of air is regular and the load on the working parts evenly distributed. Three rings at each end of the piston prevent loss of compression. The main bearing in which the eccentric shaft rotates is fitted to the side of the cylinder casting and held in place by four bolts. The other end of the shaft is supported by a small bearing within the cylinder.

Lubrication of the bearings is obtained by a small plunger pump that delivers oil from a reservoir in the base. The oil is pumped to the main bearing, where it enters the hollow shaft and is fed to each working part by outlets which allow the desired amount of oil to escape. The system is entirely automatic and needs only occasional replenishing of oil. Electrically driven models are equipped with an automatic filter. The accompanying illustration shows a motor-driven automatic tank unit, which is built in two sizes, the smaller size having a tank 14 by 36 inches, and the larger 16 by 48 inches. This line of compressors gives a range from 0 to 300 pounds per square inch.

CRESCENT TRUCK

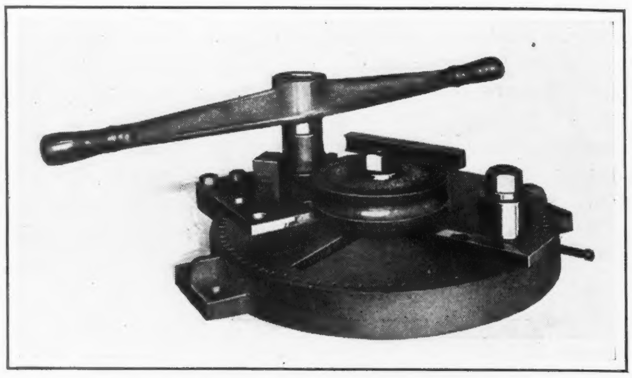
The type "G-38 Utility" truck now being built by the Crescent Truck Co., Lebanon, Pa., has an over-all folded length of only 64½ inches, which makes it possible to run the truck onto a 66-inch elevator. Because of this feature the truck is said to be especially suitable in plants constructed before self-propelling trucks were in much use. The equipment has a loading platform of 2550 square inches, and will carry a load of 4000 pounds. It has all the features of other trucks of the "General Utility" type, built by this company. The wheels are of the full-size 20-inch style, which gives ample clearance and permits the use of the truck either inside or outside of a factory. It can also be employed as a light tractor, or to push machine tools and other bulky pieces. The weight with the batteries is about 1850 pounds. The running speed, light, is 6 miles per hour, and with the rated load, 4½ miles per hour.



Crescent Utility Truck

PEDRICK PIPE AND TUBE BENDER

After considerable experimenting with a view to developing a machine for successfully bending thin-gage tubing, the Pedrick Tool & Machine Co., 3639 N. Lawrence St., Philadelphia, Pa., is placing on the market a machine intended for bending both pipe and tubing of brass, copper, or steel, without crimping or flattening. With this device it is unnecessary to previously fill the pipe or tube with sand, resin, or other reinforcing material. From the illustration it will be seen that the machine has a faceplate with gear teeth cut on its periphery which revolve in an outer casing. The hand-lever is attached to a pinion that meshes with the faceplate gear teeth, this construction giving so large a ratio that little manual effort is required for a bending operation.



Pedrick Equipment for bending Pipe and Tubing

At one side of the handle there is attached to the outer casing so that it does not move with the faceplate, a flat steel piece containing a number of holes in which a resistance stud may be suitably located. An upright stud is also fastened to the faceplate and this stud is radially adjustable by means of a set-screw. A roller on this stud reduces the friction of bending the pipe or tube. At the center of the machine there is another stud over which is slipped a grooved roll of the correct size for the diameter of the pipe or tube to be bent and of the proper radius for the shape desired. The pipe or tube is placed between the resistance and faceplate studs and the form, and is bent around the form by the faceplate stud as the faceplate is rotated. The degree or angle of the bend is determined by the arc through which the faceplate is moved. Since this can be closely controlled, any number of identical shapes may be produced without trouble. The machine may be bolted to a stand, bench, or stanchion. It will handle any length of pipe and any diameter up to 4 inches. Short pieces offer no difficulty, and this permits of cutting pipe to length, threading if necessary, and then bending to suit requirements.

FEDERAL THREAD AND THICKNESS GAGES

A thread gage for testing the lead of feed-screws, which has recently been brought out by the Federal Products Corporation, 15 Elbow St., Providence, R. I., is shown in the accompanying illustration. This gage was originally designed both for testing milling machine screws after they

Fig. 1. Federal Gage for testing Feed-screws

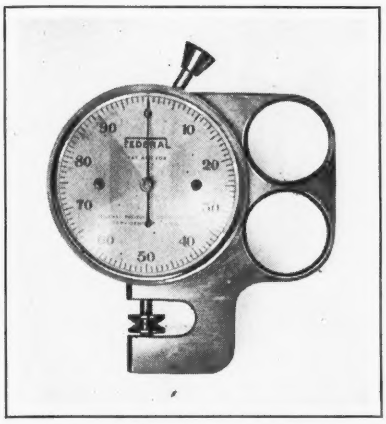


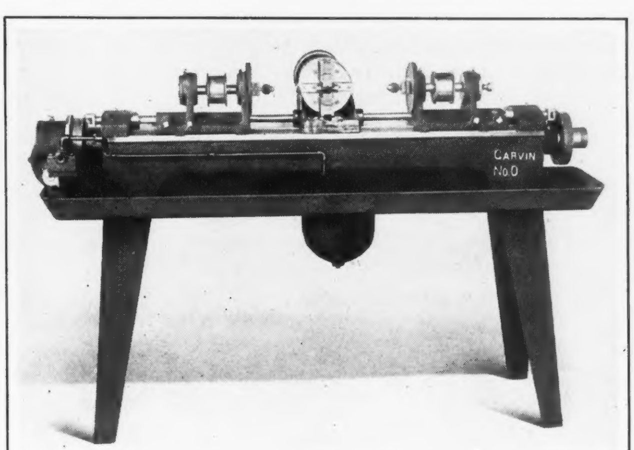
Fig. 2. Federal Thickness Gage

had been assembled in the machine, and for use at the bench. The right-hand point is interchangeable so that it can be set 1, 2, 3, 4, 5 or 6 inches distant from the left-hand point. The table is adjustable by means of a small screw in the center of the base to permit screws of different diameters to be measured, the maximum diameter which can be handled being 2 inches. The indicator can readily be removed for individual use. One of the two small screws on the opposite side of the base from the indicator is for adjusting the tension of the indicator spring. The other is for adjusting the range of the indicator hand, so that it will not snap back several revolutions when the screw being tested is removed from the table. The two screws on top are check-screws for the adjustment. The body and handle of the gage are made of aluminum, while the table is made from steel and hardened and ground.

A model 20 thickness gage for measuring sheet steel and other sheet materials is illustrated in Fig. 2. By pushing the small button on top of this gage, the jaws are opened to their full capacity, which is 0.100 inch. Both jaws are ground to an ample radius so that material can be quickly inserted. The lower jaw can be raised or lowered by turning a small adjusting screw in the bottom of its support, which allows for quickly resetting the hand at zero in case of wear. The complete gage weighs 5 ounces, and is only ½ inch thick, so that it can be carried conveniently in the vest pocket.

GARVIN DUPLEX HORIZONTAL DRILLING MACHINE

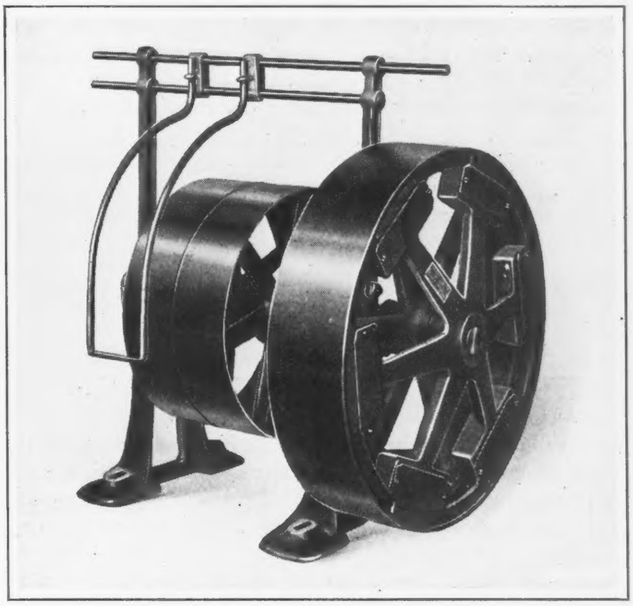
A No. 0 duplex horizontal drilling machine equipped with two heads for drilling work simultaneously from opposite sides is a recent development of the Garvin Machine Works, Spring and Varick Sts., New York City. This machine is primarily intended for the rapid drilling of small parts. The movement of the two heads to and from the work is synchronized with the opening and closing of the jaws of an air chuck in which the work is held. Power is delivered to the machine through a single pulley at the left-hand end, which drives through change-gears to a worm, the latter, in turn, driving a worm-wheel on a shaft running the length of the bed. At each end of this shaft there is a cam that governs the feeding of the heads. Contacting with each cam is a roller attached to a round bar extending through a bearing on the bed into a bearing in the corresponding head. A spring in the head exerts pressure against this end of the rod, and keeps the roller in contact with the cam to control the head movements. The length of the head movements may be varied by changing the cams to suit, and the extreme forward and return points of the movements may easily be changed to accommodate different kinds of work.



Garvin Duplex Horizontal Drilling Machine

Opening and closing of the air-chuck jaws at the proper time in relation to the head movements is regulated by the cam for the left-hand head. On this cam there is a second cam surface that actuates a roller for opening and closing the valve in the pipe line supplying air to the chuck cylinder. The head spindles are driven by belts from an overhead two-speed roller-bearing countershaft. They are mounted in ball bearings, and may be run up to a speed of 3000 revolutions per minute. The head spindles are equipped with Jacobs chucks. This equipment is designed for drilling holes up to ½ inch, and it has a swing of 9 inches. The chuck jaws are made special to suit the work to be handled.

The particular machine illustrated was set up for drilling No. 20 holes through ⅛-inch walls of small-sheave castings. Two sets of cams and change-gears were provided to give a production of 11 pieces per minute on one part, and 16 pieces per minute on another. The second rate gives a production of over 8600 pieces per nine-hour day.



Tolhurst Friction-clutch Pulley for Countershaft Drive

TOLHURST FRICTION-CLUTCH PULLEYS

Friction-clutch pulleys have recently been developed by the Tolhurst Machine Works, Troy, N. Y., for application to their centrifugal extractor, chip wringer, and metal dryers. These pulleys are made for both countershaft and individual motor drives, and are intended to replace the driving pulleys. The countershaft clutch pulley is shown in the illustration. These pulleys operate automatically on the principle of centrifugal force, and do not contain any springs or other mechanical devices. Owing to the high inertia of the machines for which the clutches are intended, a tremendous amount of power would be required to start the machines instantaneously, and so the clutches are designed to apply a reasonable and known amount of power to the machines over a short period of time until the rotating parts have come to full speed. Slow or rapid acceleration may be obtained by means of a simple adjustment of the clutches themselves.

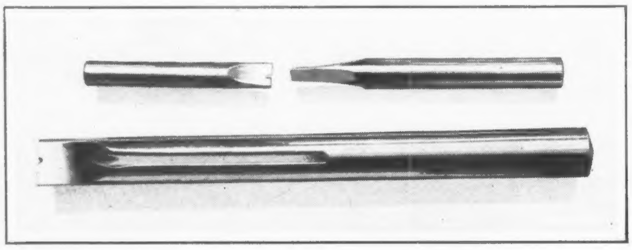
On the countershaft friction-clutch pulley the belt is shifted directly from the loose to the tight pulley, which

is on the same shaft as the clutch spider, and the shaft and spider immediately jump to full speed. As this occurs, blocks, under the influence of the centrifugal force developed, fly out in a radial direction and bear against the inside of the clutch drum or driving pulley. The friction between the blocks and the drum quickly and smoothly brings the driving pulley and its load to full speed. Slippage between the blocks and the drum ceases at full speed, and the clutch then operates as a solid pulley. Belt slippage during the starting period is done away with, and so the noise of a slipping belt and the possibility of the belt jumping the pulley are eliminated.

The motor clutch pulley operates on the same principle as the countershaft clutch pulley. A standard squirrel-cage induction motor is supplied, and the spider is rigidly connected to the rotor shaft, while the belt pulley—a combination pulley and friction drum—rides freely on a quill extension of the shaft. The motor should be thrown directly on the line, and as the motor is started under "no-load" conditions, the rotor jumps instantly to approximately 90 per cent of the full-load speed. As before, friction brings the belt pulley and its load to speed and then the motor gradually reaches full speed. The motor is started through a push-button located on the machine which operates a magnetic switch. However, this equipment may be replaced by a hand-operated knife switch.

ECONOMY CUTTERS

A line of cutters especially designed for producing keyways, slots, and oil-grooves has been brought out by the Economy Products Co., 50 Spring St., Newark, N. J. In addition to the operations mentioned, these tools may be



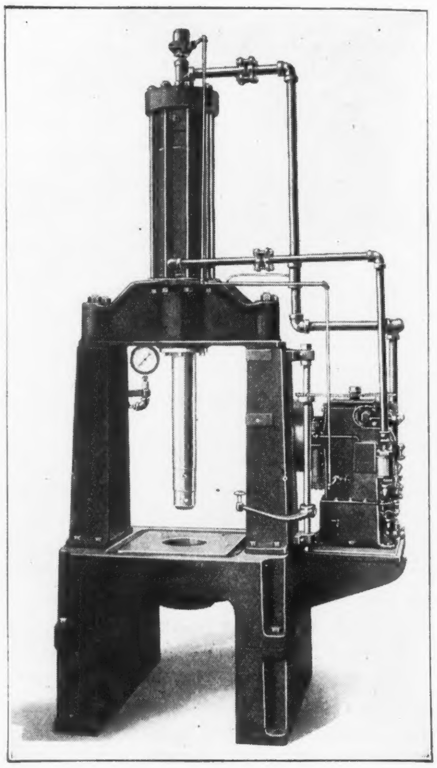
Economy Cutters for End-milling Operations

used for cutting flat-bottom holes in drilling or automatic machines, facing work, cutting deep slots on die work that other cutters cannot reach, and for numerous other operations. The cutting end is divided by a slot, on each side of which there is a cutting edge, ground at an angle opposite that of the other. The sides of the cutting end are also ground for clearance. This design of the cutting edges is said to give an exceptionally free cutting action which permits the removal of much metal in a given time. To give the necessary strength for taking deep cuts rapidly, the cutting edges are made comparatively thick.

One of the features claimed for these tools is that while they do the work of end-mills their regrinding is much simpler, as this operation can be performed on an ordinary emery wheel; also, the original diameter of the cutting edges is maintained in the regrinding. The cutters are made from high-speed steel, hardened, in sizes from 1/8 to 1 1/2 inches in diameter, with the cutting portion from 3/16 inch to 2 1/4 inches long. On the smaller sized cutters the shank is straight, and on the larger sizes it is tapered.

OILGEAR HYDRAULIC PRESSES

A self-contained line of two-column hydraulic presses of capacities ranging from 15 to 50 tons, which are intended for use in broaching, assembling, die-work, forming, embossing, straightening, and miscellaneous work where press action is required, has recently been developed by the Oilgear Co., 398 38th St., Milwaukee, Wis. These presses are equipped with the Oilgear type W variable-delivery pump described in September MACHINERY, which has a maximum delivery of 3060 cubic inches of oil per minute and a maximum pressure of 1000 pounds per square inch. Among the salient features of these presses are a sensitive control, smooth positive motion to the ram, self-contained operation, protection against damage from stalling or over-running, and rapidity of operation.

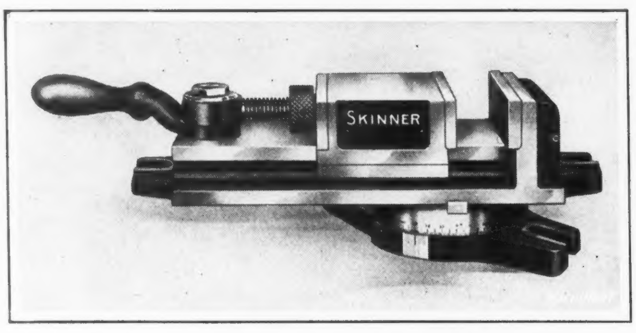


Oilgear Two-column Hydraulic Press

The "daylight space," width between columns, and stroke of ram on these machines are made to suit requirements. Various control mechanisms may be furnished for the pump, such as a plain hand control, as on the machine illustrated, foot-treadle or semi-automatic control. In all cases, a single-acting lever gives instant control of the rapid advance and return of the ram, and also of pressing speeds, regardless of the resistance offered by the work. A differential quick advance of the ram may be furnished with either a hand-lever or foot-treadle control which will allow the ram to be advanced to the work at double the pressing speed. The pump is so protected that the ram may be run against a positive stop without injury, or against work to any predetermined pressure and held at that pressure indefinitely without pulsation.

SKINNER DUAL-ACTION VISE

A dual-action vise for use on milling and drilling machines, which combines the range and convenience of a jaw-closing screw and the quick action of a cam, is being manufactured by the Skinner Chuck Co., New Britain, Conn. The illustration shows this vise mounted on a graduated swivel base which may be provided as an accessory. The major adjustment of the vise is made by rotating the collar on the screw, while a movement of the handle to either side closes the jaw with a powerful grip. The pressure of the screw is applied directly to the movable jaw in the ratio of 40 to 1. The direction of the thrust is slightly ec-



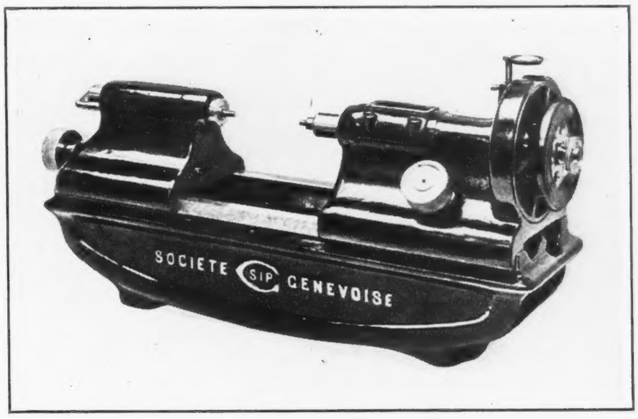
Skinner Dual-action Vise mounted on Swivel Base

centric, but this is compensated for by means of a ball nut, so that the screw is never subjected to a twisting strain.

The operating handle is always in the same plane, and the table never interferes with its operation. All parts of the vise, including the handle, are below the top of the hardened steel jaws, and thus any interference with the cutters is obviated. Special jaws may be provided to facilitate milling and drilling operations, and in this case it is often unnecessary to use jigs and fixtures. The swivel base is recommended for both tool-room and production work, and is easily adjusted through the use of a wrench. This dual-action vise is made in three sizes, the smallest of which has jaws 4 inches wide and a maximum opening of 2⅛ inches; the intermediate size, 5-inch jaws and a maximum opening of 3⅛ inches; and the largest size, 6-inch jaws and a maximum opening of 4 9/16 inches.

SOCIETE GENEVOISE BENCH MICROMETER

A series of bench micrometers has recently been added to the line of measuring equipment for machine shops manufactured by the Societe Genevoise d'Instruments de Physique, Geneva, Switzerland. The American agent for these tools is the R. Y. Ferner Co., 1410 H St., N. W., Washington, D. C. A bed with accurate ways forms the base,



Societe Genevoise Bench Micrometer for Readings to One Two-hundred Thousandths of an Inch

and the headstock which contains the micrometer screw may be set at any point along the ways. The zero anvil consists of a test comparator tube mounted in a tailstock in which the tube may be adjusted by means of a slow-motion device, to obtain the final adjustment before taking readings.

Only an occasional setting of the headstock is necessary, since the micrometer screw has a two-inch adjustment. The contact spindle does not rotate, but is advanced as a nut on the screw of the micrometer. The micrometer head is protected from injury by a shield that covers all graduations except the section opposite the vernier index. Each division of the head represents one twenty-thousandth of an inch, while the vernier index permits readings to one two-hundred thousandths of an inch, which is useful when carrying out different measurements by comparison with a gage or master piece. An adjustable reading glass facilitates reading the graduations, and a fiber handle is used for rotating the head so as to prevent the conduction of heat to the instrument from the user's hand.

The test comparator tube also serves as a pressure indicator, being pressed toward the left against a spring when in use, until a pointer moving over a scale graduated in thousandths of a millimeter, reaches the zero graduation at the end of the scale. The multiplication system is a knife-edge one, two knife-edges in the same plane bearing against a plate that carries the pointer. These micrometers are manufactured in three sizes, the smallest of which has a capacity up to 4 inches, the second up to 8 inches, and the third up to 16 inches.

An end measuring rod 4 inches in length is supplied with the smallest machine for establishing the position of the headstock at the 4-inch point, from which measurements between 2 and 4 inches may be made by means of the screw. Measurements up to 2 inches can be made by setting the headstock at the 2-inch point and establishing the zero reading with the screw extended to make contact with the zero anvil. The last fine adjustment is made by moving the anvil by means of the knurled head shown at the left-hand end of the instrument. On the 8-inch machine, 4- and 8-inch end measuring rods are supplied, and on the 16-inch machine, 4-, 8-, 12- and 16-inch end measuring rods. This micrometer can be supplied standardized for use at temperatures of either 62 or 68 degrees F., and can also be furnished graduated according to the metric system.

ATTA TOOL GRINDER

A small grinder intended for use in repair shops and garages for sharpening purposes has been placed on the market by the Atta Tool Co., 172 Union St., Worcester, Mass. The frame is made of pressed steel, and all bearings are of babbitt. It is equipped with a 4- by ½-inch wheel which is selected for rapid cutting. The motor is of the induction type without commutator, brushes, or electrical contacts, and is used by attaching to an ordinary 110-volt alternating-current lighting socket. It is fully enclosed.

NEW MACHINERY AND TOOLS NOTES

Impact Testing Machine: Pittsburg Instrument & Machine Co., 40 Water St., Pittsburg, Pa. A continuous and alternating impact testing machine for determining the elasticity of a given kind of steel by means of a test specimen. In the test, the specimen is subjected to repeated blows of a hammer, being rotated a certain amount after each blow. The number of blows required to fracture a specimen is recorded by a counter. For a "continuous" impact test, the specimen is turned 1/25 revolution between each hammer blow, while for an "alternating" test the specimen is rotated 180 degrees between each blow. The last test gives stresses such as are found in crankshafts, while the former gives tests such as develop in axles and shafts. The hammer weighs 9¼ pounds, and the dropping height is 1 3/16 inches.

Die-Casting Machine: Edgar N. Dollin, 6 Church St., New York City. An air-operated die-casting machine in which a pressure of 200 pounds per square inch is used in a cylinder to operate the die, and a pressure of 400 pounds per square inch for forcing metal into the die. The die sections are fastened to two plates, one of which is held stationary by means of four rods attached to the cylinder, while the other is mounted on the piston-rod. A feature of the machine is a valve mechanism which provides a back pressure of 100 pounds per square inch in the cylinder as the dies are closing, to insure a steady action. When the dies have been closed, the valve is operated to remove the back pressure and make the full 200-pound pressure available to hold the dies together against the pressure of the metal. The metal-heating and shooting unit is attached to the base, and the goose-neck is vertical. The melting pot has a capacity of about 1000 cubic inches. This equipment may be arranged for burning either fuel oil or gas. The shipping weight is approximately 3500 pounds.

* * *

In view of the great differences in the trademark laws of different countries, the Department of Commerce, Washington, D. C., has issued a trade information bulletin No. 155, "Trademark Protection in Europe," which gives complete information in regard to the laws for trademark protection in different European countries.

STANDARD FLANGES FOR HIGH PRESSURES

A comprehensive program for the standardization of steel flanges and flanged fittings for high steam pressures has been outlined by the American Engineering Standards Committee. The work will be under the sponsorship of the American Society of Mechanical Engineers, the Heating and Pipe Contractors' National Association, and the Committee of Manufacturers on Standardization of Fittings and Valves. The following action toward standardization has already been taken:

The maximum steam pressures for which these standard flanges and flanged fittings shall apply are 250, 400, 600, 900, 1350, 2000, and 3200 pounds per square inch. The maximum temperature for which they are to be designed is 750 degrees F.

The standards for 250- and 400-pound steam pressure per square inch are to have the same bolt circle and number of bolts as the present American cast-iron standard for 250 pounds, but are to be made from steel and the following exception is to be noted: The 2- and 2½-inch size for the 400-pound standard will have eight bolts instead of four. The other dimensions of these flanges will be modified to meet the conditions in each case.

The 600-pound standard steam flange will use as a basis for the dimensions the bolt circle and the number of bolts at present employed in the 800-pound hydraulic standard developed by the American Society of Mechanical Engineers and published in December, 1918.

The 900-pound standard steam flange will have as a basis for the dimensions the same bolt circle and number of bolts as are at present employed in the 1200-pound hydraulic standard of the American Society of Mechanical Engineers.

The standards for 1350-, 2000-, and 3200-pound steam pressures and corresponding super-heats are to be developed after the completion of the first four pressure ranges in the series. It will be noted that the seven pressures on which the flange standard is based form a geometrical series from 250 to 3200. Any communications or suggestions with regard to these standards should be addressed to C. B. LePage, secretary of Standards and Research Committees of the American Society of Mechanical Engineers, 29 W. 39th St., New York City.

* * *

IMPORTS FOR THE STEEL INDUSTRY

Probably no American basic industry is more popularly regarded as "self-contained" than the steel business. Yet the entire industry is dependent on imported manganese, and some branches, such as tinplate making, and some of the special steels, like nickel steel, are wholly dependent on foreign supplies. In the industry as a whole, twenty separate imported items, representing sixty countries or dependencies, often are used, either in the composition of the different classes of steel or in the processes of manufacture. Several of them are either not found at all in this country, like tin, or are produced in insufficient quantity, like manganese, vanadium, and nickel.—*National Foreign Trade Council.*

* * *

It is stated in *Engineering* that attempts have been made in Russia to take up the manufacture of agricultural implements and machinery. The production during 1923 was expected to reach a value of about 20,000,000 gold roubles ($10,000,000) but according to present figures it will be only about 7,900,000 roubles ($3,950,000). This, however, is 40 per cent in excess of the output in 1922. The output is being sold at prices, which, measured in gold roubles, are about 80 per cent above the pre-war level. While the price of grain has also risen, it has not kept pace with the increase that has taken place in the price of agricultural machinery and implements.

THE RAILROAD SITUATION

The managements of American railroads deserve credit for the manner in which the extremely heavy traffic of the last six months has been handled. Anticipating this year the largest traffic in their history, railroad executives on April 5 unanimously adopted a constructive program, the major purpose of which was to handle the traffic with promptness and efficiency, and if possible, without delays due to car shortage. This has been accomplished. The traffic haul has been greater than anticipated. For sixteen weeks the car loadings exceeded 1,000,000 cars; yet, ever since last June there has been a surplus of cars in good condition available for more traffic if offered. During the week when car loadings reached their peak, there was a gross surplus of over 40,000 available cars.

In 1922 the railroads purchased 146,500 freight cars, and in the first eight months of 1923, 134,600 cars. This total of approximately 280,000 cars in twenty months exceeds any previous purchase of freight cars in this period of time. During the same twenty months approximately 5800 locomotives were purchased, which exceeds the purchases of any two consecutive full years in the past.

In the last two months there has been a lull in the purchase of new equipment, but several of the middle-western railroads have recently made inquiries for additional rolling stock. Wage increases have been demanded by the employes of several railroads. The increases asked on the "Big Four" railroad range up to 39 per cent, bringing them back to the war-time peak, although the cost of living is now much less.

The Department of Commerce announces that the mileage of single track electric railway lines in 1922 is 2 per cent less than in 1917, several electrical railroads, especially in Massachusetts and Ohio, having been abandoned.

* * *

BUSINESS FORECASTING SYSTEMS

In attempting to forecast the trend of business, two fundamental principles are involved. The so-called "modern" forecasting system aims to make reliable estimates of the future by basing predictions upon the assumption that, since economic phenomena are responsive to fundamental laws, approximately similar causes should produce similar results. The interpretations of possible results is then based upon past experience. This method has much to commend it; and its value is of course dependent, in a large measure, upon the accuracy of the statistical material used and the degree to which similar material of the past is available as a basis for making real comparisons. As our information and statistics become more accurate, and as more experience in interpreting them is acquired, the greater will be the value of studies of this nature.

The stock market method, on the other hand, follows a different principle, which has also many features to commend it. It aims to predict by observing the dominant opinion upon which business men are acting after important occurrences. Thus, to the extent that current business opinion makes a proper estimate of the future, it is possible to anticipate conditions.

Both methods of attempting to predict the future of business appear to have merit; neither, however, has achieved for itself a place that makes it infallible. The factors influencing the trend of business conditions are as complicated and difficult to appraise as human nature itself. Economic factors are responsive not only to certain basic physical and so-called economic laws, but are also modified to a great extent by the injection of psychological factors of which we as yet have little understanding. For this reason great care and judgment must be exercised in dealing with economic data that aim to forecast the future. No rule-of-thumb method has yet been found that can be substituted for individual judgment and hard-headed business acumen.—*H. F. Boettler, First National Bank, St. Louis.*

PERSONALS

James J. Dale has resigned as vice-president and director of the Consolidated Machine Tool Corporation of America, Rochester, N. Y.

L. N. Burns, president of the O. E. Szekely Co., Moline, Ill., mechanical and automotive engineers, has been elected president of the Moline Chamber of Commerce.

W. H. Duley has been appointed manager of the New Haven branch of the Colonial Steel Co., Pittsburg, Pa. Mr. Duley has been district salesman at the Chicago office for a number of years.

Harry Meachem, formerly of Dean Bros., Indianapolis, Ind., has become vice-president and general manager of the Delamater Iron Works of the Rider-Ericsson Engineering Corporation, Walden, N. Y.

E. E. Helm has been appointed district manager at Detroit, Mich., for the Bridgeport Brass Co. Mr. Helm was connected for five years with the Goodyear Tire & Rubber Co., doing advertising and publicity work.

H. L. Unland, for thirteen years engineer with the General Electric Co., Schenectady, N. Y., eleven years of which were spent in the power and mining department, has become electrical engineer for the Victor Talking Machine Co., at Camden, N. J.

Thomas P. Anthony has been appointed chief engineer of the United States Cast-iron Pipe & Foundry Co., Burlington, N. J. P. T. Laws has been appointed southern district manager of the company, and will be located at 1002 American Trust & Savings Bank Bldg., Birmingham, Ala.

William Porter White has been appointed personal assistant to M. O. Troy, new executive assistant manager of the central station department of the General Electric Co., according to a recent announcement. His headquarters will probably be at Schenectady where Mr. Troy is located.

R. P. McCormick has been appointed eastern sales manager of the Pawling & Harnischfeger Co., Milwaukee, Wis., manufacturer of excavators, cranes, and machine tools. Mr. McCormick's headquarters will be at 50 Church St., New York City, and 605 Stephen-Girard Bldg., Philadelphia, Pa.

Gordon H. Stewart has been engaged by the Union Twist Drill Co., Athol, Mass., as their representative in Detroit. Mr. Stewart formerly represented the Illinois Tool Co., Chicago, Ill., in Detroit, and is well and favorably known in that territory. He began his work for the Union Twist Drill Co. November 15.

W. W. Phillips, who for the last twelve years has represented the Colonial Steel Co. as salesman in Rochester, N. Y., has been made sales manager in charge of the New York office at 149 Varick St., succeeding H. C. Poole who was recently promoted to the position of general works manager.

Guy Tripp, chairman of the board of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., has been awarded the second degree order of the Sacred Treasurer, by the Government of Japan in recognition of his activities in assisting Japanese officials in rebuilding the devastated area. This is the highest decoration that can be awarded a civilian foreigner by the Japanese Government.

Arthur Jackson has been appointed Canadian agent for the Potter & Johnston Machine Co., Pawtucket, R. I., manufacturer of automatic chucking machines, automatic milling machines, automatic piston and piston-ring machines, universal shaping machines, and screw shaving machines. He will also carry two or three other lines of American machine tools, and will be located at 177 Roxborough St., East Toronto, Ontario, Canada.

Roy Muir Ellis has been appointed New England sales manager of the Calorizing Co., Pittsburg, Pa., and will make his headquarters in Boston, Mass. Mr. Ellis was connected for seven years with the Brown & Sharpe Mfg. Co., Providence, R. I., in various executive capacities. He subsequently served as industrial engineer for the Industrial Co., Boston, and was engaged in financing, reorganization and management work. During the last two years he devoted his activities to sales promotion work.

D. I. Wheeler, who for the last eight years has been manager of the Cleveland office of the Morse Chain Co., Ithaca, N. Y., has become sales engineer for the Ramsey Chain Co., Inc., of Albany, N. Y., manufacturer of the Ramsey compensating joint silent chain. Mr. Wheeler will make his headquarters at the main office and factory of the company in Albany. Arrangements are being made by the Ramsey Chain Co. to open branch offices in the larger centers, so that users of its product will receive prompt and efficient service.

Dean K. Chadbourne, manager of the department of the Far East of the Westinghouse Electric International Co., East Pittsburg, Pa., is taking a trip to the Far East for the purpose of making a survey of business conditions in the countries in that section. He will visit Japan, China, Philippine Islands, Java, Australia, and New Zealand. Mr. Chadbourne will assist other Westinghouse officials in cooperating with Japanese officials and business men in the reconstruction of the area devastated by the recent earthquake and fire.

Charles P. Tolman has resigned as chief engineer and chairman of the manufacturing committee of the National Lead Co., with whom he has been associated for the last sixteen years, to engage in a general consulting practice. His office will be in the same building with the National Lead Co. at 111 Broadway, New York City, and he will continue to act as consulting engineer for the company. Mr. Tolman will specialize in dust and fume control, handling materials and products, and manufacturing methods and processes generally.

J. E. Franzen, general superintendent of the Bloomfield Works of the General Electric Co., has retired from his position after thirty-seven years of loyal service to the company. Mr. Franzen was born in 1858 in Sweden. He came to the United States in 1880 and was first employed here by the American Tool & Machine Co. and by the Brown & Sharpe Mfg. Co. In 1886 he entered the employ of Bergman & Co. in New York City, which company was afterward taken over by the General Electric Co. In 1904 Mr. Franzen was appointed superintendent of the Bloomfield Works of the General Electric Co. and in 1918, when this plant had been greatly increased, he was appointed general superintendent. While giving up active service, Mr. Franzen will be retained by the company as a consultant on mechanical questions, and will have charge of the purchase and disposal of machine tools.

* * *

STATEMENT OF THE OWNERSHIP, MANAGEMENT, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912

of Machinery, published monthly at New York, N. Y., for October 1, 1923.

State of New York } ss.
County of New York }

Before me, a Notary Public, in and for the state and county aforesaid, personally appeared Matthew J. O'Neill, who, having been duly sworn according to law, deposes and says that he is the treasurer and general manager of the Industrial Press, Publishers of Machinery, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, The Industrial Press, 140-148 Lafayette St., New York; Editor, Erik Oberg, 140-148 Lafayette St., New York; Managing Editor, None; Business Managers, Alexander Luchars, President, 140-148 Lafayette St., New York, and Matthew J. O'Neill, Treasurer and General Manager, 140-148 Lafayette St., New York.

2. That the owners of 1 per cent or more of the total amount of stock are: The Industrial Press; Alexander Luchars; Alexander Luchars, Trustee for Helen L. Ketchum, Elizabeth Y. Urban, and Robert B. Luchars; Matthew J. O'Neill; Louis Pelletier; and Erik Oberg. The address of all the foregoing is 140-148 Lafayette St., New York.

3. That there are no bondholders, mortgagees, or other security holders.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

MATTHEW J. O'NEILL, General Manager.

Sworn to and subscribed before me this 18th day of September, 1923.

CHARLES P. ABEL,
(SEAL) Notary Public, Kings County No. 187
Kings Register No. 5052
New York County No. 125 New York Register No. 5134
(My commission expires March 30, 1925.)

* * *

Japanese buying of iron and steel products is on the increase, and this demand, together with the unusual activity in the automobile and structural fields for this time of the year, has aided in keeping the steel mills employed at a relatively high percentage of output; but the keynote of the iron and steel market is conservative buying against future needs.

OBITUARIES

WILLIAM F. WENDT

William F. Wendt, founder and former president of the Buffalo Forge Co., Buffalo, N. Y., died at his home in Buffalo on October 30, aged sixty-five years. Mr. Wendt was born in Buffalo, and resided there throughout his life. He founded the Buffalo Forge Co., and continued as president of the company until 1916, when he retired and was succeeded by his brother Henry Wendt. He was also president of the George L. Squier Mfg. Co., the Buffalo Steam Pump Co and the W. F. Wendt Publishing Co., which published *La Hacienda*, a Spanish publication, and the *American Blacksmith*. He retired from the publishing company two years ago. Mr. Wendt was active in political work in Buffalo, although he never sought office for himself. He was keenly interested in the betterment of civic and national affairs.

EDGAR E. STRONG

Edgar E. Strong, founder and for thirty-six years head of Strong, Carlisle & Hammond Co., Cleveland, Ohio, dealer in machine tools, machinery in general, and mill supplies, died October 29, at the age of eighty-two. Mr. Strong was born near Manchester, Conn., April 14, 1841. He was educated in the district schools and in the church school of Greenwich, Conn. In 1862 he enlisted with the Sixteenth Connecticut Volunteers for the Civil War, took part in the battle of Antietam, and rising from the ranks, was later made a first lieutenant. He was taken a prisoner, and spent the last eleven months of the war in southern prisons. A year after the war, Mr. Strong came to Cleveland, and connected with W. Bingham Co., remaining with this firm for nearly twenty years. Later he engaged in the lumber business with M. G. Browne, but the yards nearly floated away in the spring floods of 1885, and the remainder was destroyed by fire in the summer. In 1887 he formed a partnership with R. H. Carlisle and W. J. Turney, the new firm selling mill supplies. L. J. Hammond took the place of Mr. Turney within a short time, and the present firm of Strong, Carlisle & Hammond was formed. Mr. Strong is survived by a son, Herbert W. Strong, now a member of the firm, and a daughter, Mrs. Warren S. Hayden, of Cleveland.

William J. Lloyd, general superintendent of the West Lynn Works of the General Electric Co., died suddenly on October 28 in an automobile as he was entering the grounds of the Tedesco Country Club in Lynn. Mr. Lloyd was born January 9, 1868 in Philadelphia. He attended Lehigh University, and was graduated with an M. E. degree. He was connected for several years with the Westinghouse Electric & Mfg. Co. and for the last twenty-five years was with the General Electric Co., four years of which were spent at the plant of the British Thomson-Houston Co. at Rugby, England. For several years he was at the Pittsfield Works of the General Electric Co. and about twelve years ago was transferred to Lynn. He assisted in establishing a plant of the company in Australia four years ago, and when he returned to Lynn in July 1922, was made general superintendent of the West Lynn Works. He is survived by a widow and one daughter.

William P. Clark, president of the Clark Tool Works, Inc., Belmont, N. Y., died at his home in Belmont on October 22 after a lingering illness. Mr. Clark was born March 11, 1851 in Unadilla Forks, N. Y. In 1877 he went to Belmont to take charge of the D. Rawson Works, manufacturers of agricultural implements, which was later reorganized into A. W. Miner & Co., with Mr. Clark as manager. In 1880 he and his brother Charles organized Clark Bros. and engaged in the manufacture of saw-mill equipment. About ten years later the company was reorganized into the Clark Bros. Co. with William P. Clark as president. At the time of his death he was vice-president and a director of this company. In 1917 he organized the Clark Tool Works located in Belmont, for the manufacture of metal-cutting band saws and general machine shop work. He was president of this company and took an active part in its management.

L. E. Voyer, assistant local sales manager of the Edison Lamp Works of the General Electric Co. at San Francisco, Cal., died October 27 of pneumonia, after a five days' illness. Mr. Voyer was well known as an illuminating engineer throughout the Pacific Coast section. He was born September 10, 1887 at Junction City, Wis., and graduated from the University of Wisconsin with the class of 1911. The same year he entered the employ of the General Electric Co. at Harrison, N. J., as a student engineer. In 1912 he was transferred to the illuminating engineering department, and in 1913 was sent to the San Francisco office as a special illuminating expert. He has been constantly in communication with illuminating engineering work in the East, being active in the work of the Illuminating Engineering Society.

NEW BOOK ON MECHANICS AND MACHINE DESIGN

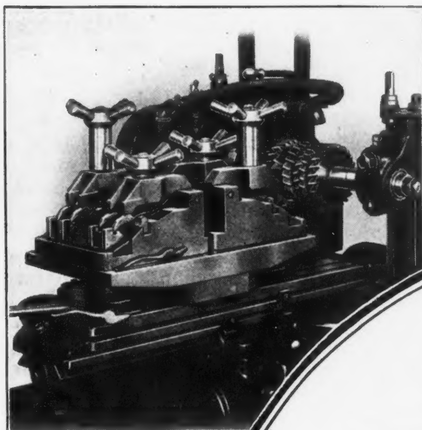
Elements of Mechanics and Machine Design. Edited by Erik Oberg. 291 pages, 6 by 9 inches; 101 illustrations. Published by The Industrial Press, 140-148 Lafayette St., New York City. Price, $3.

Every competent machine designer, regardless of his particular specialty—whether he designs machine tools, steam engines, hydraulic turbines, pneumatic machinery, hoisting and conveying apparatus, or automobiles—must possess a thorough understanding of the fundamental principles underlying the design of mechanisms in general. This treatise is intended to supply such basic knowledge. It deals first with the principles of theoretical mechanics or the action of forces, the laws governing the movement and equilibrium of bodies, and the practical application of these laws and principles. Large sums of money have been wasted on inventions that proved worthless because the designers or inventors did not understand certain fundamental mechanical laws.

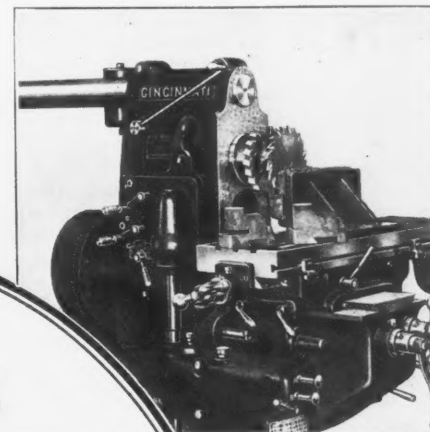
The section on theoretical mechanics is followed by several chapters explaining simply and briefly the principles and methods employed for calculating the strength of machine parts and the procedure for determining the proportion of parts that must safely withstand tensional, compression, shearing, bending or torsional stresses. After these broad principles have been presented, the general procedure in developing designs for machinery is explained, and this chapter is followed by others covering the design of important elements, such as are utilized in practically every type of mechanisms. Formulas throughout the treatise have been simplified as far as practicable, and many examples from practice are included to show just how the formulas are used. The use of standard engineering handbooks in connection with calculations for strength has been indicated, and wherever necessary or desirable, reference has been made to tables and formulas found in standard works of that kind.

The material forming the basis of several chapters in this book has appeared in Machinery. This material was obtained from prominent engineers who have dealt with subjects which, according to their experience, are of particular importance in actual designing practice.

The contents of the book are divided into nineteen chapters, headed as follows: Principles of Theoretical Mechanics; Principles of the Strength of Materials; Tension, Compression and Shearing Stresses; Beams and Bending Stresses; Torsional Stresses and Applications; Strength of Columns, Flat Plates and Cylinders; Calculating the Strength of Unsymmetrical Sections; Developing Designs for Machinery; Mechanical Transmission of Power; General Practice in the Design of Gearing; Designing Geared Driving and Feeding Mechanisms; Epicyclic or Planetary Gear Trains; Machine Keys and Multiple Splines; Plain Bearings and their Design; Principles of Flywheel Design; Designing Compression and Extension Springs; Compound Stresses; Practical Applications of Maximum Strain and Stress Theories; Design of Curved Members for Eccentric Loads.



A SELECTION OF 38 TYPES AND SIZES OF MILLING MACHINES INSURES THE *RIGHT* MACHINE FOR YOUR JOB



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On Cincinnati M Type Millers

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Milling slot and boss of taper punch on a No. 2-M Plain. Production 24 per hour. An increase of 100% over former method.

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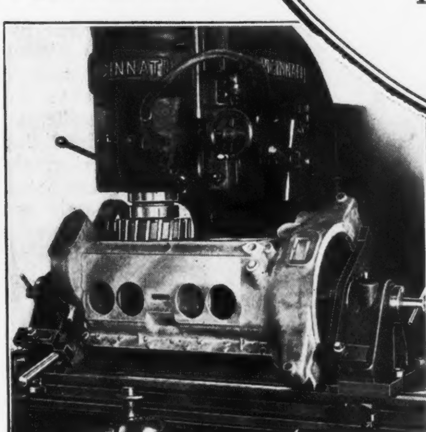

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Cylinder block faces milled one complete cylinder every 9.2 minutes. The use of fixtures on this Standard No. 4 Vertical reduced investment in Milling Machines to a minimum.

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Send in your blue-prints and samples for conservative estimates based on experience.

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Two 13" pads are milled on the piece shown in 2.6 minutes. CONE millers, lower in initial cost than Single Pulley Type Millers, handled this and many other jobs, thus saving on the amount spent on Milling Machine Installation.

CINCINNATI MILLERS

TRADE NOTES

Cleveland Duplex Machinery Co., Cleveland, Ohio, moved on December 1 to larger quarters in the Penton Building at W. Third St. and Lakeside Ave.

Bethlehem Steel Co., Bethlehem, Pa., has recently acquired the manufacturing rights to the "Selflock" type of bolts and nuts from the Selflock Nut & Bolt Co., Inc., East Syracuse, N. Y.

Mercury Mfg. Co., 4110 S. Halsted St., Chicago, Ill., has appointed Edmund Herbert Jahnz, agent for its tractors and trailers in Philadelphia and the surrounding territory. Mr. Jahnz's office is at 2009 Market St., Philadelphia.

Crescent Truck Co., Lebanon, Pa., announces that the Lincoln Products Corporation, 320 Market St., Newark, N. J., has taken over the sales rights for the Crescent electric industrial trucks and tractors in the northern part of New Jersey.

Robert R. Davis Tool Co., 3217 Alfred Ave., St. Louis, Mo., is a new concern that has been organized to manufacture adjustable reamers. The company has just completed a new factory, and production is now under way. Robert R. Davis is president of the concern, Henry P. Miller, vice-president and treasurer, and Joseph Pfeil, secretary.

Stow Mfg. Co., Inc., Binghamton, N. Y., manufacturer of flexible shafting and portable tools, has sent out a unique announcement accompanied by a German 100,000 mark bill, making the statement that just as surely as the German mark is depreciating in value, so are the cheap tools in the shop, whereas tools of proved merit retain their production efficiency and value.

Lincoln Electric Co. has moved into its new plant at Coit Road and New York Central Lines, Cleveland, Ohio. The new factory has over 185,000 square feet of manufacturing space, so laid out that materials move in and the product moves out in a continuous line. The plant is of concrete and steel, with tapestry brick exterior, of fireproof construction throughout.

P. F. McDonald & Co., 17 King Terminal, Boston, 27, Mass., dealers in steel of all grades and finishes, have published a pamphlet entitled "What is Ahead for American Business?" which contains business forecasts prepared by more than a score of the foremost industrial leaders of America, including men of national renown like Charles M. Schwab and Elbert H. Gary. Copies of the pamphlet may be had upon request.

V & O Press Co., Hudson, N. Y., manufacturer of presses and dies, and sheet-metal working machinery, has appointed the Marshall & Huschart Machinery Co., 17 S. Jefferson St., Chicago, Ill., exclusive agent for V & O products in the Chicago territory. L. F. Carlton, formerly selling agent for the company, continues as factory representative, and will cooperate with the Marshall & Huschart Machinery Co. and other western agencies.

Pioneer High-speed Machine Knife & Tool Co., Cleveland, Ohio, has been formed by A. W. Erickson, for the purpose of manufacturing shear blades and knives. A well equipped factory is now in production in Cleveland. Mr. Erickson, who heads the concern, has had thirty-one years of experience in manufacturing shear blades and knives, and has for the last seven years been superintendent of the Wapakoneta Machine Co., Wapakoneta, Ohio.

Sawbrook Steel Castings Co. has recently been organized, and is about to erect a plant for the manufacture of steel castings from electric steel material. The plant will be located in Cincinnati, and will have a capacity of about 150 tons a month, using a 1½-ton electric furnace. The officers are E. S. Sawtelle, president; A. E. Anderson, vice-president; and Edward L. Brooks, secretary-treasurer. The address of the company will be Station P, Cincinnati, Ohio.

Jones Machine Tool Works, with plants at 5300 Lansdown Ave., Philadelphia, and Primos, Pa., has recently been incorporated, and will operate in the future as the Jones Machinery Tool Works, Inc. The main office at Philadelphia will be retained for some time, and the concern will continue the manufacture of its full line of slotters, floor horizontal boring mills, and vertical mills. The officers of the company are Frank S. Jones, president; Paul D. Jones, vice-president and works manager; and D. E. Jones, secretary and treasurer.

Schubert-Christy Construction & Machinery Co., Railway Exchange Bldg., St. Louis, Mo., has been organized by Frank H. Schubert, district manager of the Wheeler Condenser & Engineering Co., and William G. Christy, secretary of the St. Louis section of the American Society of Mechanical Engineers and formerly with the St. Louis Boat & Engineering Co., to serve as representative of manufacturers of power plant equipment, and to engage in general construction engineering service, specializing in the design and construction of water cooling equipment for refrigerating and power plants, design of special machinery, process development and construction work.

Stevenson Gear Co., Indianapolis, Ind., has entered into a friendly receivership, concurred in by the controlling stock interests, creditors, and the management. F. E. Moskovics, for a number of years vice-president of the Nordyke-Marmon Co., has been appointed receiver with power to enter into negotiations for the sale of the rights to the Stevenson multiple gear shaper, and to operate the business as a going concern for at least sixty days. The shop is now operated as a jobbing shop, doing contract gear work; it has orders ahead to carry it for some time, and is also accepting contracts for the immediate future. The plant, at present, is operated in two shifts.

Chain Belt Co., Milwaukee, Wis., manufacturer of "Rex" chain, transmission machinery, and conveying equipment, formerly represented on the Pacific Coast by Meese & Gottfried Co., of San Francisco, has established direct factory branches and warehouses in Portland and Seattle. Arrangements have also been made with the Washington Machinery Depot, Tacoma, Wash., to carry a large stock of "Rex" chain and transmission machinery. The Northwest territory, with headquarters at 67 First St., Portland, Ore., will be in charge of Allen C. Sullivan, and Don B. Catton will be the special sales representative for the Portland office. The Seattle and British Columbia territory will be handled by William F. Nichols from the Seattle office located at 1040 Sixth Ave., South.

General Electric Co., Schenectady, N. Y., combined the publication and advertising departments on December 1, with Martin P. Rice, as manager of the publicity department, in charge. Frank H. Gale, advertising manager, has become assistant to D. R. Bullen and manager of conventions and exhibits. Mr. Bullen was recently appointed assistant vice-president, and Mr. Gale will do important association work. C. H. Lang, who has been assistant to Mr. Rice as manager of the publication department, will continue as assistant manager of the newly created publicity department, and T. J. McManis, who has been manager of the department of publicity for the Edison Lamp Works of the General Electric Co., at Harrison, N. J., will also become an assistant manager of the new department. An advertising council has also been created.

C. E. Johansson, Inc., Poughkeepsie, N. Y., the American company engaged in the manufacture and sale of Johansson precision gage-blocks and measuring tools, has, as already announced in the daily and trade papers, been recently purchased by the Ford Motor Co., Detroit, Mich. The purchase includes the sole American rights to the gages and methods by which they are made. The Ford Motor Co. has announced that the Johansson gage-blocks and other measuring tools will continue to be manufactured for the trade, because, since these measuring instruments are recognized standards of measurement and precision, they should be available to all who desire to purchase them. Mr. Johansson, the inventor of these gages and the methods whereby they are produced, has been engaged as a factory executive in the Ford organization. He recently arrived at Detroit from Sweden, and has begun his work at the Ford Engineering Laboratory at Dearborn, Mich.

* * *

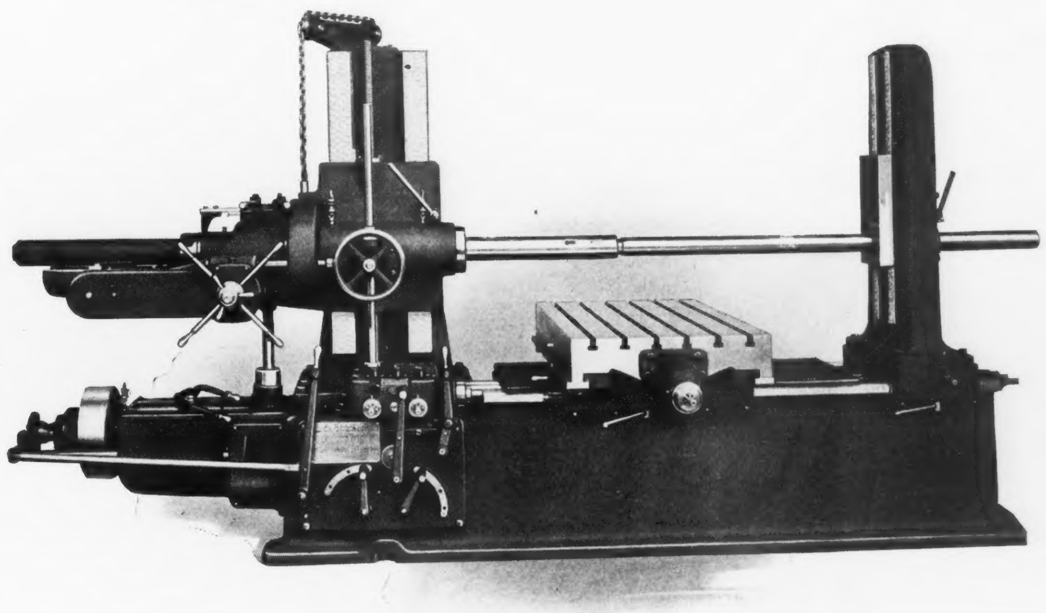
GRINDING WHEEL SPEEDS

The following grinding wheel speeds are recommended by the Norton Co., Worcester, Mass., for different types of grinding in a recent number of *Grits and Grinds*.

Type of Grinding	Recommended Peripheral Speed (Feet per Minute)	Maximum Peripheral Speed (Feet per Minute)
Cylindrical grinding	5500	6500
Internal grinding	5000	6000
Snagging and general off-hand grinding on bench and floor stands	5000	6000
Surface grinding	4000	5000
Knife grinding	3500	4000
Hemming cylinders	2100	2400
Wet tool grinding	5000	6000
Cutlery grinding	4000	5000
Shellac and rubber cutting-off wheels	9000	12000

Machinery

"A ship is a ship only when she's sailing"—
And so a boring machine is a boring machine only when she's boring; and the same with a drilling or a milling machine.

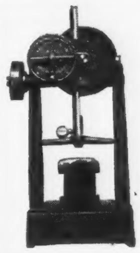


When the

"PRECISION"

Boring, Drilling and MILLING MACHINE

is not doing one thing she is doing another, and often does all three at one setting of the work, therefore *Never Stands Idle.*



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FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry. Societe Anonyme Belge, Alfred Herbert, Brussels. Allied Machinery Co., Turin, Barcelona, Zurich. V. Lowener, Copenhagen, Christiania, Stockholm. R. S. Stokvis & Zonen, Rotterdam. Andrews & George Co., Tokyo.

COMING EVENTS

December 3-6—Annual meeting of the American Society of Mechanical Engineers in New York City. Secretary, Calvin W. Rice, 29 W. 39th St., New York City.

December 3-8—Second annual exposition of power and mechanical engineering in the Grand Central Palace, New York City.

December 5-8—Winter meeting of the American Institute of Chemical Engineers in Washington, D. C. Secretary, J. C. Olsen, Polytechnic Institute, Brooklyn, N. Y.

January 22-25—Annual meeting of the Society of Automotive Engineers in the General Motors Building, Detroit, Mich. Secretary, Coker F. Clarkson, 29 W. 39th St., New York City.

April 28-30—Annual meeting of the American Gear Manufacturers' Association at Buffalo, N. Y. Secretary, T. W. Owen, Room 107, 2443 Prospect Ave., Cleveland, Ohio.

April 30-May 2—Eleventh convention of the Society of Industrial Engineers in Buffalo, N. Y. Executive secretary, George C. Dent, 608 S. Dearborn St., Chicago, Ill.

May 19-22—Spring meeting of the American Society of Mechanical Engineers at Cleveland, Ohio. Calvin W. Rice, secretary, 29 W. 39th St., New York City.

June 4-6—Eleventh annual foreign trade convention in Boston, Mass. O. K. Davis, India House, Hanover Square, New York City, secretary.

NEW BOOKS AND PAMPHLETS

Magnesium. 177 pages, 4¼ by 6¾ inches. Published by the American Magnesium Corporation, Niagara Falls, N. Y. Price, $2.50.

The commercial possibilities of magnesium are attracting wide attention at the present time, owing to its light weight combined with strength. Consequently, this handbook of information and data relating to the use of magnesium and magnesium alloys should be of interest to those who wish to be informed on this subject. The book discusses in considerable detail the chemical, physical, and mechanical properties of magnesium, and contains chapters on methods of fabrication and uses. Although the contents are intended particularly for engineers and metallurgists, an attempt has been made to compile the book in such a manner as to make it valuable also to one not technically trained who may be interested in an application for some form of the metal.

Practical Control of Electrical Energy. By A. G. Collis. 157 pages, 5¼ by 8¼ inches; 42 illustrations. Published by the Oxford University Press, American Branch, 29 W. 32nd St., New York City. Price, $3.50.

Engineers who have to do with the operation and control of electrical equipment will be interested in this new contribution to the literature in the field of electricity. This book contains descriptive technical data relating to the design of electrical apparatus and machinery as applied to everyday practice. The aim is to explain and solve alternating- and direct-current problems intelligently without the introduction of complicated equations and formulas. The material is divided into five chapters headed as follows: Terms of Expression; Instruments and Systems; Protective Gear; Miscellaneous Electrical Apparatus; and Notes on Factory and Mining Regulations.

Advertising Campaigns. By Harry Tipper and George French. 423 pages, 6 by 9 inches. Published by the D. Van Nostrand Co., 8 Warren St., New York City. Price, $4.

This book serves a twofold purpose: First and principally it is a reference and guide for advertising managers and account executives on the mechanical details of the organization, operation, and handling of a national or local advertising campaign. It comprises an analytical survey of the factors that determine the success of any campaign. The book discusses market analysis, the planning of the campaign, and its operation and handling. Some recent outstanding effective campaigns are discussed in detail and the reasons for their success traced to the basic principles outlined in this book. Second, it is intended to serve as a text-book for business schools and universities that offer advertising courses. In matters of arrangement the authors have been guided by teaching practice.

Self-Taught Mechanical Drawing and Elementary Machine Design. By F. L. Sylvester. 345 pages, 5 by 7½ inches; 237 illustrations. Published by the Norman W. Henley Publishing Co., 2 W. 45th St., New York City. Price, $2.50.

This is the third edition of a work covering the first principles of geometric and mechanical drawing, work-shop mathematics, mechanics, strength of materials, and the design of machine details, including cams, sprockets, gearing, shafts, pulleys, belting, couplings, screws and bolts, clutches, flywheels, etc. The book is elementary in nature, and the material is presented in such a way as to meet the needs of the student whose previous theoretical knowledge is limited. The author's aim has been to adapt the material to the requirements of the mechanic and the young draftsman, and to present the matter in as clear and concise a manner as possible, in order to make self-study easy. With this in mind, the important elements of machine design have been dealt with, and in addition algebraic formulas have been explained and the elements of trigonometry have been dealt with.

The Welding Encyclopedia. Compiled and edited by L. B. Mackenzie and H. S. Card of the editorial staff of "Welding Engineer." 437 pages, 6 by 9 inches; 600 illustrations. Published by the Welding Engineer Publishing Co., 608 S. Dearborn St., Chicago, Ill. Price, $5.

This is the third edition of a reference and instruction book on the theory and practice of all the welding processes. The different terms and trade names used in welding practice are arranged alphabetically in the form of an encyclopedia, and are carefully defined. Especially important words and terms are made the subject of complete illustrated treatises. Following the encyclopedia section of the book are chapters on oxy-acetylene welding, electric arc welding, thermit welding, and resistance welding. Additional chapters treat separately of boiler welding, pipe welding, tank welding, and rail joint welding, both by the gas and electric processes. One of the sections tells how to install and care for welding apparatus, and a special chapter deals with the subject of the heat-treatment of steel. A collection of charts and tables of welding information is also included. At the end of the book is a catalogue section in which are illustrated and described welding apparatus and supplies. A new feature of the third edition is the chapter on training operators, which contains a complete outline of lessons, followed by a set of exercises and a set of examinations.

NEW CATALOGUES AND CIRCULARS

Standard Turbine Corporation, Scio, N. Y., is issuing a publication known as the "Standard Turbine Bulletin," which will contain articles on steam turbine design and performance.

Herman H. Sticht & Co., 15 Park Row, New York City. Circular descriptive of the "Kritiskope," a light self-contained sensitive instrument for locating the critical points in heat-treating steel.

Hauck Mfg. Co., 126 Tenth St., Brooklyn, N. Y. Bulletin 506, illustrating and describing the Hauck venturi low-pressure oil burner, operating with air pressures of from 8 ounces to 2 pounds.

Edison Lamp Works of General Electric Co., Harrison, N. J. Bulletin L. D. 150, treating of the lighting of steel mills and foundries. Bulletin L. D. 148, containing information on lighting legislation.

Wagner Electric Corporation, St. Louis, Mo. Folder descriptive of the Fynn-Weichsel motor, a new type of constant-speed alternating-current motor, operating as a slip-ring induction motor at synchronous speed.

Champion Electric Co., 3711-3741 Forest Park Blvd., St. Louis, Mo. Catalogue descriptive of the features of mechanical construction of Champion direct-current and single-, two- or three-phase 60-cycle constant-speed motors.

Adams Co., 1910 Market St., Dubuque, Iowa. Catalogue 30, entitled "Labor Savers for the Foundry," illustrating and describing the line of plain and universal molding machines, flask equipment, etc., made by this concern.

Electric Controller & Mfg. Co., Cleveland, Ohio. Bulletins 1042-D and 1045-A, illustrating and describing, respectively, automatic compensators for alternating-current squirrel-cage motors, and type NC squirrel-cage induction motors.

Crouse-Hinds Co., Syracuse, N. Y. Circular illustrating and describing the application of flanged obround condulets for supporting wiring fixtures and conduit systems The circular also shows covers and wiring devices for these condulets.

Reo Motor Car Co., Lansing, Mich. Booklet descriptive of the apprenticeship courses offered by this company for training boys to become machinists, toolmakers, designers, and draftsmen. A special course has just been added for dealers' shop men.

Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. Catalogue descriptive of the Westinghouse new model multiple retort underfeed stoker, which is built in all types and sizes to meet specifications for industrial and central station requirements.

De Laval Steam Turbine Co., Trenton, N. J. Pamphlet descriptive of the De Laval flexible coupling, which has been developed for use in connection with turbines or other motors geared or direct-coupled to pumps, generators, and similar machinery.

Nazel Engineering & Machine Works, 4043 N. 5th St., Philadelphia, Pa. Circular descriptive of the Whipple Model No. 1 4-inch motor-driven bench jointer. The circular describes the features of construction and gives specifications covering dimensions, weight, type of motor, etc.

National Tube Co., Frick Bldg., Pittsburg, Pa. Pamphlet entitled "Seven Wonders of Wrought Pipe," describing seven different actual cases in which National wrought pipe was subjected to unusually severe tests without failure, showing the strength, uniformity, and durability of wrought pipe.

Fulton Iron Works Co., St. Louis, Mo. Catalogue 805, of Fulton-Diesel engines, dealing with the construction, cycle of operation, fuel consumption, lubrication, erection, etc. A large number of illustrations show actual installations of these engines and successive steps in the erection are also shown.

Crescent Machine Co., 56 Main St., Leetonia, Ohio. Catalogue illustrating and describing the Crescent new model universal woodworker, No. 101 to 112, which consists of five separate units—a band saw, jointer, saw table, shaper, and borer—so that five different kinds of work can be done on the machine at one time.

Davis Boring Tool Co., Inc., Forest Park Blvd. and Spring Ave., St. Louis, Mo. Railroad bulletin No. 1, illustrating and describing Davis expansion boring tools and expansion reamers for railroad shops. The special field of application of the different types is pointed out in connection with the illustrations of the tools.

North Side Tool Co., Dayton, Ohio. Circular descriptive of the amplifying gages made by this concern, which are adapted for the rapid gaging of either cylindrical or flat work, and are applicable for use in inspecting production work or measuring tool-room jobs. The circular contains illustrations showing a number of typical applications.

Selflock Nut & Bolt Co., Inc., East Syracuse, N. Y. Bulletin of "Selflock" screw thread products, illustrating and describing the features of the "Selflock" form of thread which is applicable to railway nuts and bolts, carriage and machine bolts, track bolts, nuts and bolts for the automotive industry, cap-screws, or wherever locking bolts or nuts are desirable.

Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill., is distributing a wall chart, which is intended to be tacked up in toolrooms for use in ordering repair parts for "Thor" electric drills of 1/2, 9/16, 5/8, and 3/4 inch capacity. The chart contains a list of the interchangeable parts for these drills and symbol numbers for use in ordering.

Elecdrive Mfg. Co., Inc., Syracuse, N. Y. Catalogue of the "Elecdrive" universal wrench, drill, stud- and screw-driver, which is designed for use in rapidly starting and driving nuts, studs, and screws. These tools can also be used on drilling and reaming operations. They are made in five sizes, three of which are portable and two stationary machines.

Curtis Pneumatic Machinery Co., 1568 Kienlen Ave., St. Louis, Mo. Circular commemorating the seventieth anniversary of the founding of this concern. The circular shows sketches of the first small building occupied by the Curtis organization in 1854, and the present 17½ acre Curtis plant. The company manufactures air hoists, single and double I-beam cranes, single I-beam trolleys, and air compressors.

Armstrong Bros. Tool Co., 313 N. Francisco Ave., Chicago, Ill. New general catalogue B-23, covering the line of lathe and planer tools, ratchet drills, drop-forged wrenches, lathe dogs, clamps, and pipe tools made by this concern. The company has recently entered the pipe tool field, and Armstrong pipe dies, vises, cutters, etc., are listed for the first time in this catalogue. New and revised list prices for the various tools are included.

Geometric Tool Co., New Haven, Conn. Pamphlet illustrating the line of single-spindle and double-spindle threading machines produced by this company. The machines are described in detail, and specifications are given for the different sizes. Outline drawings of the different types of machines with the various parts numbered and corresponding lists of parts are included. The booklet also illustrates the Geometric bench threading machine and the Geometric tapping machine.

Reliance Electric & Engineering Co., 1056 Ivanhoe Road, Cleveland, Ohio. Pamphlet entitled "Electric Motors—How to Choose and Use Them," containing information on how a motor operates; installing the power supply; "load factor" and motor cost; individual or group drive; protection and installation of the motor; method of determining size of motor required; keeping motors fit; starters and regulators; fuse protection; and applications of different kinds and sizes of motors.

W. A. Jones Foundry & Machine Co., 4409 W. Roosevelt Rd., Chicago, Ill. Catalogue 27, containing information on cast-iron pulleys, including weights, special types, rubber covering list, etc. The catalogue also illustrates and describes Lemley ball-bearing loose pulleys and ring-oiling loose pulleys. Steel, wood, and paper pulleys are also listed. Catalogue L-28, on friction clutches, containing new data on Lemley friction clutches. Sleeve clutches, cut-off couplings, and clutch pulleys are covered, dimensions, prices and horsepower ratings being given.

Garrison Gear Grinder Co., Dayton, Ohio. Catalogue descriptive of the Garrison gear grinder, a precision machine that finishes both sides of gear teeth to a predetermined size and form by a generating process at one operation with one wheel. The catalogue contains a brief history of the origin of the machine, and describes in detail the features of construction and the operation of these grinders. Illustrations are also included, showing these machines in operation, together with detailed information as to their construction and methods of production. The last section of the catalogue describes the inspection devices and gages used for testing the gears ground on these machines.